



06/23/97

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Box Patent Applications

Case Docket No. FUJI 14.341

Filed by Express Mail

(Receipt No. FH366727505)on June 23, 1997

pursuant to 37 C.F.R. 1.10

by [Signature]

Sir:

Transmitted herewith for filing is: ☒ a new patent application
☐ a c-i-p application of S.N. _____ filed _____

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For: MOBILE COMMUNICATION SYSTEM ENABLING EFFICIENT USE OF
SMALL-ZONE BASE STATIONS

Enclosed are:

- ☒ 32 sheets of drawing ☒ Informal ☐ Formal (Figs. 1-20, 21A, 21B, 22-32)
☒ Specification, including claims and abstract (106 pages)
☒ Declaration
☒ An assignment of the invention to FUJITSU LIMITED
☐ A certified copy of _____ Application No. _____
☒ An associate power of attorney
☐ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
☒ Post card
☒ Recording fee (as indicated below)
☐ Information Disclosure Statement, PTO-1449, copies of _____ references
☐ Other _____
☐ Other _____

	Col. 1	Col. 2
FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	35 -20 =	15
INDEP CLAIMS	12 -3 =	9
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENTED		

*If the difference in Col. 1 is less than
zero, enter "0" in Col. 2

SMALL ENTITY			OTHER THAN A SMALL ENTITY	
RATE	FEE		RATE	FEE
	\$385	OR		\$770
X 11 =	\$	OR	X 22 =	\$330
X 40 =	\$	OR	X 80 =	\$ 720
X 130 =	\$	OR	X 260 =	\$
TOTAL	\$		TOTAL	\$ 1820

- ☐ Please charge our Deposit Account No. 08-1634 the amount of \$_____ to cover the filing fee and recording fee (if any).
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Respectfully submitted,

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00880633-062397

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In a mobile communication system, radio
35 base stations operated on a small transmission power
and forming microcells or picocells are provided at
the center of a big city characterized by a

1 particularly large volume of traffic so that a
multilayer cell is formed.

Radio base stations operated on a small
transmission power are also provided in an underground
5 passage and a tunnel in order to enlarge a radio zone
sufficiently to eliminate a dead zone.

Fig. 1 shows a construction of a
conventional mobile communication system.

Referring to Fig. 1, radio base
10 stations 61_1 and 61_2 form adjacent radio zones 62_1 and
 62_2 , respectively. In the radio zone 62_1 , a radio
base station 61_3 forming a microcell 63 and a radio
base station 61_4 forming a picocell 64 are provided so
as to form a multilayer. Mobile stations $65_1 - 65_N$
15 are located movable in the radio zones 62_1 and 62_2 ,
the microcell 63 and the picocell 64.

In the radio base station 61_1 , an
antenna 66_1 is connected to an antenna terminal of a
transmission and reception unit 68_1 via a common
20 antenna equipment unit 67_1 . A control terminal of the
transmission and reception unit 68_1 is connected to an
input and output terminal of a base station control
device 69_1 . A line terminal provided in the
transmission and reception unit 68_1 and a
25 communication port of the base station control device
 69_1 are connected to a control station (not shown) via
a transmission device 70_1 and a communication link
 71_1 .

Since the radio base stations $61_2 - 61_4$
30 have the same construction as the radio base station
 61_1 , the corresponding elements are designated by
using suffixes 2 - 4 in the description below, and the
illustration and description thereof are omitted.

An antenna 72_1 of the mobile station
35 65_1 is connected to an antenna terminal of a
transmission and reception unit 74_1 via a common
antenna equipment unit 73_1 . A modulated input and a

1 demodulated output of the transmission and reception
unit 74₁ are connected to a microphone 75₁ and a
speaker 76₁, respectively. A control terminal of the
transmission and reception unit 74₁ is connected to a
5 control terminal of a control unit 77₁. An input and
output terminal of the control unit 77₁ is connected
to a display and operation unit 78₁.

Since the construction of the mobile
stations 65₂ - 65 is the same as the mobile station
10 65₁, the corresponding elements are designated by
using suffixes 2 - N in the description below, and the
illustration and description thereof are omitted.

The base station control device 69₁ of
the radio base station 61₁ in the above-described
15 mobile communication system is directed by a center
(not shown) via the communication link 71₁ and the
transmission device 70₁ to generate announcement
information including a wait enabled level and a wait
disabled level as shown in Fig. 2 and transmits the
20 announcement information to a predetermined control
radio channel (hereinafter, simply referred to as a
control channel) via the transmission and reception
unit 68₁, the antenna common equipment unit 67₁ and
the antenna 66₁.

25 In addition to the wait enabled level
and the wait disabled level, the announcement
information also includes a message type identifying
transmitted information as the announcement
information, a mobile station transmission power
30 specification specifying a transmission power of the
mobile station, a location code indicating a location
of the radio zone (service area), and the like.
However, the information items other than the wait
enabled level and the wait disabled level does not
35 have to do with the present invention, and the
description thereof is omitted.

The control unit 77₁ of the mobile

1 station 65₁ maintains a control channel table listing
all the radio channels over which the announcement
information described above is transmitted from the
radio base stations forming the respective radio zones
5 to which the mobile station 65₁ may be located.
Further, upon power-on, the control unit 77₁ measures
sequentially the electric field intensity L_1 of the
control channel registered in the control table
10 unit 74₁ ((1) of Fig. 3). A determination is then
made as to whether or not the measured electric field
intensity is greater than a predetermined threshold
level L_{th} ((2) of Fig. 3).

The control unit 77₁ registers the
15 control channels for which a determination that the
measured electric field intensity is greater than the
threshold level L_{th} is obtained, in a prescribed area
(hereinafter, referred to as a candidate zone
register) in a main memory. The electric field
20 intensity of the registered control channel is also
registered in the candidate zone register so that the
correspondence between the control channel and the
associated electric field intensity is specified ((3)
of Fig. 3).

25 When the control unit 77₁ has completed
a series of the above-described processes
(hereinafter, referred to as a measurement process)
for all the control channels registered in the control
channel table, the control unit 77₁ determines whether
30 or not the candidate zone register stores any control
channel ((4) of Fig. 3). If an affirmative answer is
given, the control unit 77₁ sorts the entries in the
candidate zone register according to the ascending
order of the electric field intensity ((5) of Fig. 3).

35 The control unit 77₁ refers to the
candidate zone register when the sorting process has
been completed and receives the announcement

1 information via the individual control channels
registered in the candidate zone register ((6) of Fig.
3). The control unit 77_1 measures the electric field
intensity again ((7) of Fig. 3). Further, the control
5 unit 77_1 compares the electric field intensity L_2 and
the wait enabled level L_{th} included in the
announcement information ((8) of Fig. 3). When the
former is lower in level than the latter, a similar
comparison is conducted for the other control channels
10 registered in the candidate zone register ((9) of Fig.
3). Hereinafter, a series of processes performed
subsequent to the measurement process is referred to
as a zone determination process. The control unit 77_1
restarts the measurement process when the electric
15 field intensity is found to be below the wait enabled
level L_{th} for all the control channels subjected to
the comparison ((10) of Fig. 3).

If the electric intensity field of any
of the control channels is found to be equal to or
20 exceeds the wait enabled level, the control unit 77_1
establishes that control channel as a control channel
for the radio zone in which the mobile station is to
register its location, issues a call and receives an
incoming call ((11) of Fig. 3). Thereafter, the
25 control unit 77_1 enter a wait state ((12) of Fig. 3).

The operations relating to registering
of a location, issuing of a call or receiving of an
incoming call performed by the mobile station 65_1 and
the radio base station 61_1 are not directly related to
30 the present invention, and the description thereof
will be omitted below.

The operation performed by the radio
base stations $61_2 - 61_4$ is the same as the above-
described operation of the radio base station 61_1 , and
35 the description thereof is omitted. Also, the
operation performed by the mobile stations $65_2 - 65_N$
is the same as the above-described operation of the

1 mobile station 65_1 , and the description thereof is
omitted.

In the conventional system described
above, if the mobile station 65_1 is located inside the
5 microcell 63 and near the border with respect to the
radio zone 62_1 , as indicated by the broken line in
Fig. 4, and if the electric field intensity of the
radio wave arriving from the radio base station 61_1
is higher than that of the radio wave received from
10 the radio base station 61_3 , the mobile station 65_1 is
set up for a wait in the radio zone 62_1 . As
illustrated, the radio zone 62_1 is formed outside the
microcell 63 in which the mobile station 65_1 is
actually located.

15 In such a case, the microcell 63 and
the picocell 64 provided with the aim of handling a
large volume of traffic are not accessed by the mobile
station 65_1 . The traffic otherwise handled by the
microcell 63 is imposed as a load on the radio base
20 station 61_1 , thus causing the operating efficiency and
the service quality to be dropped.

When the propagation loss of the radio
wave that arrives at the mobile station 65_1 from the
radio base station 61_1 increases due to the
25 propagation characteristic of the radio transmission
channel varying depending on the speed of the mobile
station mobile station 65_1 and the path of the
movement, the mobile station 65_1 may leave a zone when
it is not necessary and performs the measurement
30 process. Even when a call originated in the mobile
station 65_1 becomes a successful call so that a
conversation is established without the mobile station
 65_1 leaving the zone, the speech quality may be
dropped if there is a large propagation loss, with the
35 result that switching of message channels occur too
frequently during the conversation.

Given that the microcell 63 or the

1 picocell 64 is provided in order to serve the dead
area located inside the radio zone 62₁, the mobile
station 65₁ may be set up for a wait in a radio zone
located outside the cell (the microcell 63 or the
5 picocell 64) in which the mobile station 65₁ is
actually located. In this case, the microcell 63 or
the picocell 64 remain unused so that the dead area is
not efficiently served, a first aspect of the problem
with the conventional mobile communication system.

10 A description will now be given, with
reference to Fig. 5, of the flow of call origination
operation in the conventional mobile communication
system, in order to explain a second aspect of the
problem with the conventional mobile communication
15 system. In the following explanation of the second
aspect, the PDC mobile communication system employed
primarily in Japan is assumed.

In the conventional mobile
communication system, when the user of a mobile
20 station turns the power on (ST701), the mobile station
measures a reception level of a perch channel provided
for a base station (ST702). A perch channel is a term
used in the PDC mobile communication system to refer
to a channel provided for each of the base stations to
25 allow a mobile station to determine a reception level
with respect to the base station. In the PDC system,
a perch channel is mainly used to transmit
announcement information from the base station to the
mobile station. The claims refer to a perch channel
30 as a reception-level determining channel. If it is
determined that the reception level exceeds a
predetermined level (YES in ST703), the mobile station
sorts the perch channels according to the ascending
order of reception levels and stores the perch
35 channels and the associated reception levels in a
memory provided in the mobile station (ST704). A
determination is then made as to whether the reception

1 levels in all the perch channels have been measured
(S705).

5 If no perch channels and associated
reception levels are stored in the memory (NO in
S706), the mobile station displays an out-of-the-zone
message in a display device (S707). When perch
channels and associated reception levels are stored in
the memory (YES in S706), the mobile station measures
the reception level in the perch channel having the
10 highest reception level according to the memory. If
it is determined that the measured reception level
exceeds a wait enabled level contained in the
announcement information from the base station, the
mobile stations is set up for a wait in the base
15 station providing the highest reception level (S708).

The mobile station in a wait state
sends a call request to the base station in which it
is set up for a wait (S709). The mobile station
notifies the base station of the perch channel codes
20 and the reception levels provided by the base stations
other than the notified base station.

If the level of reception from the
mobile station issuing the request exceeds a
predetermined level that enables assigning of a
25 message channel (YES in S710), and if there is an
unused message channel (YES in S711), the base station
receiving the request from the mobile station assigns
a message channel to the requesting mobile station
(S712). If the level of reception from the mobile
30 station is below the predetermined level (NO in S710),
or if there is no unused message channel (NO in S711),
the base station receiving the request refers to the
reception levels of the adjacent base stations
reported by the mobile station and designates one of
35 the adjacent base stations as a base station for the
requesting mobile station (S713).

The mobile station that receives, from

1 the base station, a signal for assigning a message
channel can use the assigned message channel to
establish a call connection with the corresponding
base station (S714).

5 Thus, the mobile station located at a
point where there is an overlap of a plurality of
zones formed by respective base stations is set up for
a wait in the base station whose perch channel
provides the highest reception level. When
10 originating or receiving a call, the mobile station
issues a request for a message channel to the base
station in which the mobile station is set up for a
wait.

However, it is not always best for the
15 mobile station in the mobile communication system to
issue a request for a message channel to the base
station providing the highest reception level in the
perch channel.

A relatively large service area formed,
20 for example, by the base station A as shown in Fig. 31
is assumed. This large-zone construction formed by
the base station A may include an area characterized
by a concentrated traffic, resulting in a shortage of
message channels in that area. In order to remedy
25 this shortage, the base station B having a smaller
transmission power and capable of forming a smaller-
zone construction than the base station A is provided
within the service area formed by the base station A.
Provision of the base station B would serve the
30 intended purpose if a mobile station within the zone
formed by the base station B requests a message
channel from the base station B.

However, a problem with the
conventional mobile communication system is that the
35 mobile station requests a message channel from the
base station A providing a higher reception level than
the base station B instead of requesting it from the

1 base station B provided to handle an increased local
traffic, with the result that the base station B
remains unused to handle call originating or call
incoming in the mobile station.

5

SUMMARY OF THE INVENTION

Accordingly, a general object of the
present invention is to provide a mobile communication
system and a mobile station apparatus in which the
10 aforementioned problems of the conventional system are
eliminated.

Another and more specific object of the
present invention is to provide a mobile communication
system and a mobile station apparatus in which a radio
15 base station adapts itself to a dynamically
established traffic distribution, or in which a mobile
station can most successfully enter a radio zone in
which it is actually located so as to be set up for a
wait therein.

20 Still another object of the present
invention is to assign order of priority to a
plurality of base stations constituting a mobile
communication system so that a mobile station requests
a message channel from a base station having a higher
25 priority than others in order to start communicating
via that base station.

Fig. 6 is a block diagram of a mobile
communication system according to claim 1 of the
present invention. The mobile communication system
30 according to claim 1 comprises a plurality of radio
base stations $1_1 - 1_N$ forming respective radio zones
and effecting a radio channel setting control in
accordance with a predetermined procedure, and a
mobile station 2 selecting, as a wait zone, one of the
35 radio zones that satisfies a criteria demanded by the
predetermined procedure, and receiving communication
service via the selected wait zone. Each of the radio

1 base stations $1_1 - 1_N$ comprises a traffic control unit
3 for setting a traffic distribution for the plurality
of radio zones, and an announcing unit 4 for
generating announcement information including the
5 order of priority assigned to the plurality of radio
zones, the order of priority being assigned in
accordance with a probability density given to each of
the plurality of radio zones under the distribution
set by the traffic control unit 3, and for
10 transmitting the announcement information to the radio
zone formed by the radio station to which the
announcing unit 4 belongs. The mobile station 2
comprises an announcement information receiving unit 5
for receiving the announcement information transmitted
15 by the announcing unit 4 in accordance with the
predetermined procedure, and a wait control unit 6 for
selecting one of the radio zones as a wait zone, the
radio zone to which a highest priority is assigned
being a first candidate for selection by the wait
20 control unit 6.

Fig. 7 shows a mobile communication
system according to claim 2 of the present invention.
The mobile communication system according to claim 2
comprises: a plurality of radio base stations $11_1 -$
25 11_N forming one or a plurality of radio zones and one
or a plurality of small-scale radio zones, resulting
in a hierarchy of overlapping radio zones, and
effecting a radio channel setting control in
accordance with a predetermined procedure; and a
30 mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
base stations $11_1 - 11_N$, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
35 plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13 for transmitting announcement
information which includes identification information

1 for identifying radio channels assigned to respective
radio zones and small-scale radio zones, via the radio
channel assigned to the radio zone formed by the radio
base station to which the announcing unit 13 belongs,
5 the identification information being arranged in the
announcement information so as to correspond to the
hierarchy of overlapping radio zones. The mobile
station 12 comprises: an announcement information
receiving unit 14a for receiving the announcement
10 information transmitted by the announcing unit 13a, in
accordance with the procedure for radio channel
setting control; a measuring unit 15a for measuring an
electric field intensity for the radio channel
corresponding to the identification information
15 included in the announcement information received by
the announcement information receiving unit 14a; and a
wait control unit 16a for comparing an electric field
intensity measured by the measuring unit 15a with a
preset threshold level, and designating a radio zone
20 to which the radio channel lowest in the hierarchy is
assigned as a wait zone in which to receive the
communication service, on the condition that the
electric field intensity measured by the measuring
unit 15a exceeds the preset threshold level.

25 The mobile communication system
according to claim 3 comprises: a plurality of radio
base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
radio zones, resulting in a hierarchy of overlapping
30 zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
base stations $11_1 - 11_N$, in accordance with a
35 predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
plurality of radio base stations $11_1 - 11_N$ comprises

1 an announcing unit 13a for transmitting announcement
information which includes identification information
for identifying the one or the plurality of radio
5 radio zones, via the radio channel assigned to the
radio zone formed by the radio base station to which
the announcing unit 13a belongs, the identification
information being arranged in the announcement
10 hierarchy of overlapping zones. The mobile station 12
comprises: an announcement information receiving unit
14a for receiving the announcement information
transmitted by the announcing unit 13a, in accordance
with the procedure for radio channel setting control;
15 a measuring unit 15a for measuring an electric field
intensity for the radio zone corresponding to the
identification information included in the
announcement information received by the announcement
information receiving unit 14a; and a wait control
20 unit 16a for comparing an electric field intensity
measured by the measuring unit 15a with a preset
threshold level, and designating, as a wait zone in
which to receive the communication service, a radio
zone lowest in the hierarchy of overlapping zones on
25 the condition that the electric field intensity
measured by the measuring unit 15a exceeds the
threshold level.

The mobile communication system
according to claim 4 comprises: a plurality of radio
30 base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
radio zones, resulting in a hierarchy of overlapping
zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
35 mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
base stations $11_1 - 11_N$, in accordance with a

1 predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13b for transmitting announcement
5 information which includes identification information
for identifying radio channels for the one or the
plurality of radio zones and the one or the plurality
of small-scale radio zones, via the radio channel
assigned to the radio zone formed by the radio base
10 station to which the announcing unit 13b belongs, the
identification information being arranged in the
announcement information according to respective
positions in the hierarchy of overlapping zones. The
mobile station 12 comprises: an announcement
15 information receiving unit 14b for receiving the
announcement information transmitted by the announcing
unit 13b, in accordance with the procedure for radio
channel setting control; a measuring unit 15b for
measuring an electric field intensity for the radio
20 channel corresponding to the identification
information included in the announcement information
received by the announcement information receiving
unit 14b; and a wait control unit 16b for comparing an
electric field intensity measured by the measuring
25 unit 15b with a preset threshold level, and
designating one of the radio channels, which is
assigned to the radio zone lowest in the hierarchy and
for which the control unit 16b has determined that the
electric field intensity measured by the measuring
30 unit 15b exceeds the preset threshold level, as a
radio channel via which to receive the communication
service.

The mobile communication system
according to claim 5 comprises: a plurality of radio
35 base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
radio zones, resulting in a hierarchy of overlapping

1 zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
5 base stations $11_1 - 11_N$, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13c for transmitting announcement
10 information which includes identification information
for identifying the one or the plurality of radio
zones and the one or the plurality of small-scale
radio zones, via the radio channel assigned to the
radio zone formed by the radio base station to which
15 the announcing unit 13c belongs, the identification
information being arranged in the announcement
information according to respective positions in the
hierarchy of overlapping zones. The mobile station 12
comprises: an announcement information receiving unit
20 14c for receiving the announcement information
transmitted by the announcing unit 13c, in accordance
with the procedure for radio channel setting control;
a measuring unit 15c for measuring an electric field
intensity for the radio zone corresponding to the
25 identification information included in the
announcement information received by the announcement
information receiving unit 14c; and a wait control
unit 16c for comparing an electric field intensity
measured by the measuring unit 15c with a preset
30 threshold level, and designating, as a wait zone in
which to receive the communication service, a radio
zone identified by the identification information to
be lowest in the hierarchy of overlapping zones, on
the condition that the electric field intensity
35 measured by the measuring unit 15a exceeds the
threshold level.

The mobile communication system

1 according to claim 6 comprises: a plurality of radio
base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
5 zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
base stations $11_1 - 11_N$, in accordance with a
10 predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13d for transmitting announcement
information which includes first identification
15 information for identifying a radio channel assigned
to the radio zone formed by the radio base station to
which the announcing unit 13d belongs, as well as
including second identification information
identifying the radio zones and the small-scale radio
20 zones which overlap the radio zone formed by the radio
base station to which the announcing unit 13d belongs,
via the radio channel assigned to the radio zone
formed by the radio base station to which the
announcing unit 13d belongs, the second identification
25 information being arranged in the announcement
information according to respective positions in the
hierarchy of overlapping zones. The mobile station 12
comprises: an announcement information receiving unit
14d for receiving the announcement information
30 transmitted by the announcing unit 13d, in accordance
with the procedure for radio channel setting control;
a measuring unit 15d for measuring an electric field
intensity for the radio channel corresponding to the
identification information included in the
35 announcement information received by the announcement
information receiving unit 14d; and a wait control
unit 16d for comparing an electric field intensity

1 measured by the measuring unit 15d with a preset
threshold level, determining the radio channel which
is identified by the associated second identification
information, if available, to have a lowest
5 hierarchical order, and designating, as a wait zone in
which to receive the communication service, the radio
zone to which the determined radio channel is
assigned, on the condition that the electric field
intensity measured by the measuring unit 15d exceeds
10 the threshold level.

The mobile communication system
according to claim 7 comprises: a plurality of radio
base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
15 radio zones, resulting in a hierarchy of overlapping
zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
20 base stations $11_1 - 11_N$, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13e for transmitting announcement
25 information which includes first identification
information for identifying a radio channel assigned
to a radio zone formed by the radio base station to
which the announcing unit 13e belongs, as well as
including second identification information
30 identifying the radio zones and the small-scale radio
zones which overlap the radio zone formed by the radio
base station to which the announcing unit 13e belongs,
over the radio zone formed by the radio base station
to which the announcing unit 13e belongs, the second
35 identification information being arranged in the
announcement information according to respective
positions in the hierarchy of overlapping zones. The

1 mobile station 12 comprises: an announcement
information receiving unit 14e for receiving the
announcement information transmitted by the announcing
unit 13e, in accordance with the procedure for radio
5 channel setting control; a measuring unit 15e for
measuring an electric field intensity for the radio
zone corresponding to the identification information
included in the announcement information received by
the announcement information receiving unit 14e; and a
10 wait control unit 16e for comparing an electric field
intensity measured by the measuring unit 15e with a
preset threshold level, determining the radio zone
corresponding to the radio channel which is identified
by the associated second identification information,
15 if available, to have a lowest hierarchical order, and
designating the determined radio zone as a wait zone
in which to receive the communication service on the
condition that the electric field intensity measured
by the measuring unit 15e exceeds the threshold level.

20 The mobile communication system
according to claim 8 comprises: a plurality of radio
base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
radio zones, resulting in a hierarchy of overlapping
25 zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
mobile station 12 accessing one of the radio zones
formed by the respective one of the plurality of radio
base stations $11_1 - 11_N$, in accordance with a
30 predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13f for transmitting announcement
information which includes a hierarchical (equal or
35 subordinate) order of the radio zone formed by the
radio base station to which the announcing unit 13f
belongs with respect to the overlapping radio zones

1 and small-scale radio zones, and which also includes
identification information for identifying radio
channels assigned to the radio zone formed by the
radio base station to which the announcing unit 13f
5 belongs and the overlapping radio zones and small-
scale radio zones, via the radio channel assigned to
the radio zone formed by the radio base station to
which the announcing unit 13f belongs. The mobile
station 12 comprises: an announcement information
10 receiving unit 14f for receiving the announcement
information transmitted by the announcing unit 13f, in
accordance with the procedure for radio channel
setting control, for extracting the identification
information from the announcement information, and for
15 determining the hierarchy of the radio zones to which
the radio channels identified by the identification
information are assigned; a measuring unit 15f for
measuring an electric field intensity for the radio
channel corresponding to the identification
20 information obtained by the announcement information
receiving unit 14f; and a wait control unit 16f for
comparing an electric field intensity measured by the
measuring unit 15f with a preset threshold level, and
designating a radio zone to which the radio channel
25 lowest in the hierarchy is assigned as a wait zone in
which to receive the communication service, on the
condition that the electric field intensity measured
by the measuring unit 15f for the radio channel lowest
in the hierarchy exceeds the preset threshold level.

30 The mobile communication system
according to claim 9 comprises: a plurality of radio
base stations $11_1 - 11_N$ forming one or a plurality of
radio zones and one or a plurality of small-scale
radio zones, resulting in a hierarchy of overlapping
35 zones, and effecting a radio channel setting control
in accordance with a predetermined procedure; and a
mobile station 12 accessing one of the radio zones

1 formed by the respective one of the plurality of radio
base stations $11_1 - 11_N$, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone. Each of the
5 plurality of radio base stations $11_1 - 11_N$ comprises
an announcing unit 13g for transmitting announcement
information which includes a hierarchical (equal or
subordinate) order of the radio zone formed by the
radio base station to which the announcing unit 13g
10 belongs with respect to the overlapping radio zones
and small-scale radio zones, and which also includes
identification information for identifying the radio
zone formed by the radio base station to which the
announcing unit 13g belongs and the overlapping radio
15 zones and small-scale radio zones, over the radio zone
formed by the radio base station to which the
announcing unit 13g belongs. The mobile station 12
comprises: an announcement information receiving unit
14g for receiving the announcement information
20 transmitted by the announcing unit 13g, in accordance
with the procedure for radio channel setting control,
for extracting the identification information from the
announcement information, and for determining the
hierarchy of the radio zones corresponding to the
25 identification information; a measuring unit 15g for
measuring an electric field intensity for the radio
zone corresponding to the identification information
extracted by the announcement information receiving
unit 14g; and a wait control unit 16g for comparing an
30 electric field intensity measured by the measuring
unit 15g with a preset threshold level, and
designating a radio zone lowest in the hierarchy
determined by the announcement information receiving
unit 14g as a wait zone in which to receive the
35 communication service, on the condition that the
electric field intensity measured by the measuring
unit 15g for the radio zone lowest in the hierarchy

1 exceeds the preset threshold level.

The announcing unit of the mobile communication system according to claim 10 comprises a unit for adding, in the announcement information, preset threshold values individually provided for the radio zone formed by the radio base station to which the announcing unit belongs and the overlapping radio zones and small-scale radio zones, resulting in a hierarchy that corresponds to the hierarchy of overlapping zones. The wait control unit 16 employs the threshold values added to the announcement information by the announcing unit in making comparisons with the electric field intensity.

The announcing unit of the mobile communication system according to claim 11 comprises a unit for adding a relative value indicating the preset threshold value for the zone formed by the radio base station to which the announcing unit belongs, in the form of a difference with respect to a reference value for the threshold value. The announcement information receiving unit includes a unit for determining the relative value added to the announcement information, in relation to the radio zone in which the announcement information is received. The wait control unit compares the electric field intensity measured by the measuring unit with a sum of the reference value and the relative value determined by the announcement information receiving unit in relation to the radio zone in which the electric field intensity is measured.

The announcing unit of the mobile communication system according to claim 12 comprises a unit for adding relative values indicating the preset threshold values for the radio zone formed by the radio base station to which the announcing unit belongs and the overlapping radio zones and small-scale radio zones, in the form of differences with

1 respect to a reference value common to the threshold
values, resulting in a hierarchy that corresponds to
the hierarchy of overlapping zones. The wait control
unit compares the electric field intensity with a sum
5 of the relative value and the reference value.

 The mobile station 12 of the mobile
communication system according to claim 13 comprises a
zone determination unit 17 for performing a cyclic
measurement of the electric field intensity of the
10 radio zones in which the mobile station 12 can be
located, comparing a measured electric field intensity
with a lower acceptance value by which an entry into
the radio zone is enabled, stopping processes of
measurement and comparison when it is found that the
15 former exceeds the latter, and selecting the
associated radio zone as a candidate in which the
announcement information receiving unit 14 is to
receive the announcement information.

 The wait control unit of the mobile
20 communication system according to claim 14 compares
the electric field intensity measured by the measuring
unit with the threshold value in the descending order
of the hierarchy in the radio zones subject to the
measurement, and designates the radio zone for which
25 it is found that the former exceeds the latter as a
wait zone.

 The measuring unit of the mobile
communication system according to claim 15 comprises a
unit which omits a measurement of the radio zone
30 selected by the zone determination unit 17 and
substitutes therefor the electric field intensity
measured by the zone determination unit.

 Fig. 8 is a block diagram showing the
invention described in claim 16.

35 The mobile station according to claim
16 comprises an announcement information receiving
unit 21 for receiving announcement information

1 including orders of priority assigned to radio zones
formed by a plurality of radio base stations, the
reception by the announcement information receiving
unit 21 being conducted according to a descending
5 order of preset traffic distribution and in accordance
with a radio channel setting control procedure; a wait
unit 23 for determining whether the radio zone
associated with the order of priority included in the
announcement information received by the announcement
10 information receiving unit 21 satisfies a criteria
adapted for the radio channel setting control
procedure, and for designating the radio zone for
which an affirmative answer is given as a wait zone;
and a communication control unit 25 which receives
15 communication service from the radio base station
forming the radio zone designated by the wait unit 23.

The mobile communication system
according to claim 17 comprises: a plurality of base
stations forming respective radio zones that overlap
20 each other; a mobile station transportable between
said radio zones; wherein each of said plurality of
base stations comprises: announcing means for sending
announcement information including an order of
priority of said plurality of base stations to the
25 mobile station located in one of said radio zones, and
said mobile station comprises: control means for
selecting the base station to which a request for a
message channel is to be issued, based on the order of
priority of the base stations included in the
30 announcement information transmitted from said
plurality of base stations.

According to this aspect of the present
invention, the base station as shown in Fig. 31 in
which the mobile station is set up for a wait
35 transmits the announcement information that includes
the order of priority specifying, for example, that
the base station B be given the priority over the base

Since the mobile station requests a message channel from the base station B instead of the base station A providing a higher reception level, the base station B can be used efficiently to handle call originating and call incoming in the mobile station.

20 According to this aspect of the present
invention, the announcement information receiving
means of the mobile station receives the announcement
information including the order of priority of the
base stations from, for example, the base station A
25 and the base station B as shown in Fig. 31. The
transmission means of the mobile station transmits a
request for a message channel from a base station
selected by the control means. For example, the
mobile station may send the request to the base
30 station B having the highest priority.

The mobile station according to claim 19 further comprises: storage means for storing the announcement information; measuring means for measuring a reception level in reception-level
35 determining channels in a descending order of priority of said plurality of base stations, based on the announcement information stored in said storage means

1 and including the order of priority and based on
information relating to the reception-level
determining channels.

5 According to this aspect of the present
invention, the memory means of the mobile station
stores the announcement information received by the
announcement information receiving means from, for
example, the base station A and the base station B as
shown in Fig. 31 and including the order of priority
10 of the base stations. Measurement of the reception
level by the measuring means starts with the base
station B having the highest priority, based on the
order of priority of the base stations A and B stored
in the storing means and the information relating to
15 the perch channel corresponding to the respective base
stations. The measuring means notifies the control
means of the reception level.

Therefore, the mobile station stores
the order of priority of the base stations included in
20 the announcement information received by the
announcement information receiving means and notifies
the control means of the reception level so that
selection can be made on the base station to which a
request for a message channel is to be issued. In
25 this way, the control means is able to select the base
station B to which the request should be sent.

The control means according to claim 20
includes determining means for determining whether the
reception level in a reception-level determining
30 channel is equal to or exceeds a predetermined level
that enables a request for a message channel.

According to this aspect of the present
invention, the control means of the mobile station can
determine whether the reception level of the perch
35 channel of, for example, the base station A or the
base station B as shown in Fig. 31 is equal to or
exceeds a predetermined level.

1 The announcing means according to claim
21 includes first arranging means for ordering the
announcement information so as to arrange information
relating to reception-level determining channels in a
5 descending order of priority.

According to this aspect of the present invention, the announcing means of, for example, the base station A as shown Fig. 31 can order the announcement information such that information relating to the perch channel of the base station A and that of the base station B are arranged in the order of priority.

The announcing means according to claim 22 includes second arranging means for ordering the announcement information so as to couple information relating to each reception-level determining channel to an order of priority associated therewith.

According to this aspect of the present invention, the announcing means of, for example, the base station A as shown in Fig. 31 can order the announcement information such that information relating to the perch channel of the base station A is coupled to the priority assigned thereto and information relating to the perch channel of the base station B is coupled to the priority assigned thereto.

The transmission means according to claim 23 includes first transmission means for issuing a request for a message channel to the base station selected by the control means when a call is
30 originated.

According to this aspect of the present invention, the control means of the mobile station as shown in Fig. 31 can select the base station B assigned the highest priority when the mobile station
35 originates a call, so that the transmission means can request a message channel from the base station B.

The transmission means according to

1 claim 24 includes second transmission means for
issuing a request for a message channel to the base
station selected by the control means when a call is
incoming.

5 According to this aspect of the present
invention, the control means of the mobile station as
shown in Fig. 31 can select the base station B
assigned the highest priority when the mobile station
receives an incoming call, so that the transmission
10 means can request a message channel from the base
station B.

The transmission means according to
claim 25 includes third transmission means for
transmitting a request for a communication to the base
15 station selected by the control means when a message
channel is switched from one to another in the event
of a handover of a call.

According to this aspect of the present
invention, the control means of the mobile station as
20 shown in Fig. 31 can select the base station B
assigned the highest priority when a switching of
channels occurs in the event of a handover, so that
the transmission means can request a message channel
from the base station B.

25 The mobile station according to claim
26 comprises control means for selecting a base
station to which a request for a message channel is to
be issued, based on an order of priority of a
plurality of base stations included in announcement
30 information from said plurality of base stations.

Referring to 31, based on the
announcement information from the base station A
including the order of priority of the base stations A
and B, the mobile station can request a message
35 channel from the base station B instead of the base
station A providing a higher reception level. Thus,
the base station B, provided to handle an increased

1 local traffic, can be efficiently used to handle call
originating and call incoming in the mobile station.

The mobile station according to claim
27 comprises: announcement information receiving means
5 for receiving, from said plurality of base stations,
the announcement information including the order of
priority of said plurality of base stations; and
transmission means for transmitting a request for a
message channel to the base station selected by said
10 control means.

According to this aspect of the present
invention, the announcement information receiving
means of the mobile station receives the announcement
information including the order of priority of the
15 base stations from, for example, the base station A
and the base station B as shown in Fig. 31. The
transmission means of the mobile station transmits a
request for a message channel from a base station
selected by the control means. For example, the
20 mobile station may send the request to the base
station B having the highest priority.

The mobile station according to claim
28 comprises: storage means for storing the
announcement information; measuring means for
25 measuring a reception level in reception-level
determining channels in a descending order of priority
of said plurality of base stations, based on the
announcement information stored in said storage means
and including the order of priority and based on
30 information relating to the reception-level
determining channels.

According to this aspect of the present
invention, the memory means of the mobile station
stores the announcement information received by the
35 announcement information receiving means from, for
example, the base station A and the base station B as
shown in Fig. 31 and including the order of priority

1 of the base stations. Measurement of the reception
level by the measuring means starts with the base
station B having the highest priority, based on the
order of priority of the base stations A and B stored
5 in the storing means and the information relating to
the perch channel corresponding to the respective base
stations. The measuring means notifies the control
means of the reception level.

Therefore, the mobile station stores
10 the order of priority of the base stations included in
the announcement information received by the
announcement information receiving means and notifies
the control means of the reception level so that
selection can be made on the base station to which a
15 request for a message channel is to be issued. In
this way, the control means is able to select the base
station B to which the request should be sent.

The control means according to claim 29
includes determining means for determining whether the
20 reception level in a reception-level determining
channel is equal to or exceeds a predetermined level
that enables a request for a message channel.

According to this aspect of the present
invention, the control means of the mobile station can
25 determine whether the reception level of the perch
channel of, for example, the base station A or the
base station B as shown in Fig. 31 is equal to or
exceeds a predetermined level.

The transmission means according to
30 claim 30 includes first transmission means for issuing
a request for a message channel to the base station
selected by the control means when a call is
originated.

According to this aspect of the present
35 invention, the control means of the mobile station as
shown in Fig. 31 can select the base station B
assigned the highest priority when the mobile station

1 originates a call, so that the transmission means can
request a message channel from the base station B.

The transmission means according to
claim 31 includes second transmission means for
5 issuing a request for a message channel to the base
station selected by the control means when a call is
incoming.

According to this aspect of the present
invention, the control means of the mobile station as
10 shown in Fig. 31 can select the base station B
assigned the highest priority when the mobile station
receives an incoming call, so that the transmission
means can request a message channel from the base
station B.

15 The transmission means according to
claim 32 includes third transmission means for
transmitting a request for a communication to the base
station selected by the control means when a message
channel is switched from one to another in the event
20 of a handover of a call.

According to this aspect of the present
invention, the control means of the mobile station as
shown in Fig. 31 can select the base station B
assigned the highest priority when a switching of
25 channels occurs in the event of a handover, so that
the transmission means can request a message channel
from the base station B.

The base station according to claim 33
comprises: announcing means for sending announcement
30 information including an order of priority of a
plurality of base stations constituting the mobile
communication system to a mobile station located in
one of the radio zones.

A mobile communication system as shown
35 in Fig. 31 is assumed. The base station A forms a
relatively large service area (zone) and a base
station B having a smaller transmission power than the

1 base station A forms a relatively small service area
(zone) inside the service area formed by the base
station A. The mobile station is set up for a wait in
the base station A. According to the invention of
5 claim 33, the base station A can transmit the
announcement information including the order of
priority of the base stations. For example, the base
station B could be given a higher priority over the
base station A according to the announcement
10 information.

The announcing means according to claim
34 includes first arranging means for ordering the
announcement information so as to arrange information
relating to reception-level determining channels in a
15 descending order of priority.

According to this aspect of the present
invention, the announcing means of, for example, the
base station A as shown Fig. 31 can order the
announcement information such that information
20 relating to the perch channel of the base station A
and that of the base station B are arranged in the
order of priority.

The announcing means according to claim
35 includes second arranging means for ordering the
announcement information so as to couple information
relating to each reception-level determining channel
25 to an order of priority associated therewith.

According to this aspect of the present
invention, the announcing means of, for example, the
base station A as shown in Fig. 31 can order the
announcement information such that information
30 relating to the perch channel of the base station A is
coupled to the priority assigned thereto and
information relating to the perch channel of the base
station B is coupled to the priority assigned thereto.
35

BRIEF DESCRIPTION OF THE DRAWINGS

1 Other objects and further features of
the present invention will be apparent from the
following detailed description when read in
conjunction with the accompanying drawings, in which:

5 Fig. 1 shows a construction of a
conventional mobile communication system;

 Fig. 2 shows a construction of
conventional announcement information;

10 Fig. 3 is a flowchart of a conventional
operation;

 Fig. 4 illustrates a problem with the
conventional mobile communication system;

 Fig. 5 is a flowchart showing the
conventional call origination operation;

15 Fig. 6 is a block diagram of a mobile
communication system according to the invention
described in claim 1;

 Fig. 7 is a block diagram showing a
principle of the invention described in claims 2 - 15;

20 Fig. 8 is a block diagram showing a
principle of the invention described in claim 16;

 Fig. 9 is a flowchart of an operation
of a system according to the invention described in
claims 2, 3, 14 - 16;

25 Fig. 10 shows a format of announcement
information according to an embodiment that
corresponds to the invention described in claims 2 and
3;

30 Fig. 11 is a flowchart of an operation
according to an embodiment that corresponds to the
invention described in claims 4 - 9, 14 and 15;

35 Fig. 12 shows a format of announcement
information according to an embodiment that
corresponds to the invention described in claims 4 -
7;

 Fig. 13 shows a format of announcement
information according to an embodiment that

1 corresponds to the invention described in claims 8 and
9;

Fig. 14 is a flowchart of an operation
according to an embodiment that corresponds the
5 invention described in claims 10, 14 and 15;

Fig. 15 shows a format of announcement
information according to an embodiment that
corresponds to the invention described in claim 10;

Fig. 16 is a flowchart of an operation
10 according to an embodiment that corresponds to the
invention described in claims 11, 12, 14 and 15;

Fig. 17 shows announcement information
according to an embodiment that corresponds to the
invention described in claims 11 and 12;

15 Fig. 18 is a flowchart of an operation
according to an embodiment that corresponds to the
invention described in claims 13 - 15;

Fig. 19 shows a mobile communication
system directed to resolving the problem with the
20 conventional message channel assigning operation;

Fig. 20 shows a mobile communication
system to which the present invention is applied;

Fig. 21A shows how the announcement
information is delivered;

25 Fig. 21B shows the principle of the
flow of the call origination operation according to
the present invention;

Fig. 22 shows a format of the
announcement information according to the present
30 invention;

Fig. 23 shows another format of the
announcement information according to the present
invention;

35 Fig. 24 shows still another format of
the announcement information according to the present
invention;

Fig. 25 is a flowchart showing the flow

1 of the call origination operation according to the
present invention;

Fig. 26 shows a sequence of the call
origination operation according to the present
5 invention;

Fig. 27 shows the flow of the call-
incoming operation according to the present invention;

Fig. 28 shows the sequence of the call-
incoming operation according to the present invention;

10 Fig. 29 shows the flow of a recall
channel switching operation according to the present
invention;

Fig. 30 shows the sequence of the
recall channel switching operation according to the
15 present invention;

Fig. 31 shows how base stations are
ordered;

Fig. 32 shows a hardware construction
of a base station assumed in the present invention;
20 and

Fig. 33 shows a hardware construction
of a mobile station assumed in present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

25 The inventive feature of an embodiment
that corresponds to the invention described in claim 1
consists in the constitution of the announcement
information sent by the base station control devices
69₁ - 69₄ of the radio base stations 61₁ - 61₄ to the
30 control channel, and in the procedure of radio channel
setting control effected by the control units 77₁ -
77_N of the mobile stations 65₁ - 65_N, respectively, in
accordance with the announcement information. The
hardware configuration of the system according to the
35 embodiment that corresponds to the invention described
in claim 1 is the same as the conventional system
shown in Fig. 1, and the description thereof is

1 omitted.

The radio base stations $61_1 - 61_4$ correspond to the radio base stations $1_1 - 1_N$ shown in Fig. 6, respectively. Each of the radio base stations $1_1 - 1_N$ includes the respective traffic control unit 3 and the announcing unit 4. The mobile stations $65_1 - 65_N$ correspond to the mobile station 2 which includes the announcement information receiving unit 5 and the wait control unit 6.

10 A description will now be given, with reference to Fig. 1, of the operation of the system that corresponds to the invention described in claim 1.

Each of the base station control devices $69_1 - 69_4$ of the radio base stations $61_1 - 61_4$, respectively, maintains a data base (not shown). Such a data base assigns a weight to each of the radio base stations $61_1 - 61_4$ so as to arrange the radio base stations $61_1 - 61_4$ in the order of priority. The weight is determined by a condition such as the operating mode and the current traffic. The operating mode could include the day of the week, the time zone of the day and the like.

Each of the base station control devices $69_1 - 69_4$ also monitors calls originated in mobile stations located in a radio zone formed by the respective base station, so that the traffic in that radio zone can be measured. The measured traffic is reported to the other base stations via a communication link (not shown).

Further, each of the base station control devices $69_1 - 69_4$ refers to the above-mentioned data base against the traffic measured locally, the traffic reported by the other base stations, and the day of the week and the time zone, so as to determine a combination of weights suitable for the combination of the ongoing traffic. Each of

1 the base station control devices $69_1 - 69_4$ then
incorporates the determined combination in the
announcement information in relation to the respective
radio zones $62_1 - 62_4$ (or the radio base stations 61_1
5 - 61_4). The announcement information is transmitted
via the transmission and reception units $68_1 - 68_4$,
the common antenna equipment units $67_1 - 67_4$ and the
antennas $66_1 - 66_4$.

The control unit 77_1 of the mobile
10 station 65_1 effects a measurement process and a zone
determination process as in the conventional system.
Given that there are a plurality of candidate radio
zones which the mobile station 65_1 may enter, the
radio zone to which the greatest weight is assigned in
15 the announcement information is selected as the first
candidate zone for entry so that the control unit 77_1
can enter a wait state.

Thus, according to the embodiment that
corresponds to the invention described in claim 1, the
20 distribution of the mobile stations set up for a wait
in respective radio zones can be varied dynamically so
as to be adapted for the operating condition and the
operating mode of the radio base stations. Therefore,
maintenance and operating requirements are flexibly
25 met and the resources such as the radio base stations
and the radio frequencies are effectively utilized.

In the above-described embodiments, the
weights are determined by the traffic distribution in
the radio zones, the day of the week and the time
30 zone. However, the weight may be appropriately
provided in correspondence with events detected in the
process of the monitoring control and the radio
channel setting control effected by the radio base
stations. Such events may be various failures and
35 releases therefrom, or congestions in radio channels.

Fig. 8 is a flowchart of an operation
of the mobile communication system according to

1 embodiments that correspond to the invention described
in claims 2, 3 and 14 - 16.

5 The inventive feature of the
embodiments that correspond to the invention described
in claims 2, 3 and 14 - 16 consists in the
constitution of the announcement information sent by
the base station control devices $69_1 - 69_4$ of the
radio base stations $61_1 - 61_4$ to the control channel,
and in the procedure of radio channel setting control
10 process effected by the control units $77_1 - 77_N$ of the
mobile stations $65_1 - 65_N$, respectively, in accordance
with the announcement information. The hardware
configuration of the embodiments that correspond to
the invention described in claims 2, 3 and 14 - 16 is
15 the same as that of the conventional system shown in
Fig. 1, and the description thereof is omitted.

20 The radio base stations $61_1 - 61_4$
correspond to radio base stations $11_1 - 11_N$ which
include announcing units 13 and 13a - 13g,
respectively. The mobile stations $65_1 - 65_N$
correspond to a mobile station 12 which includes one
of announcing information receiving units 14 and 14a -
14g (in the case of claim 2) or an announcing
information receiving unit 21 (in the case of claim
25 16). The mobile station 12 also includes one of
measuring units 15 and 15a - 15g, one of wait control
units 16 and 16a - 16g, an entry determining unit 17,
a wait unit 23, and a communication control unit 25.

30 A description will now be given of the
operation of the system according to embodiments that
correspond to the invention described in claims 2, 3
and 16. For the sake of simplicity of the
description that follows, it is assumed that the
mobile station 65_1 is located in the same location
35 assumed in the description of the related art.

In the absence of a hierarchy of radio
zones (hereinafter, referred to as overlap zones)

1 embodied by a microcell 63, a picocell 64 and the like
at respective locations in a radio zone formed by the
radio base station 61₁, the base station control
device 69₁ of the radio base station 61₁ transmits the
5 announcement information having the same format as
that of the conventional announcement information as
shown in Fig. 2, via the transmission and reception
unit 68₁, the common antenna equipment unit 67₁ and
the antenna 66₁.

10 If there are overlap zones, the base
station control device 69₁ is provided by a control
station (not shown) with an identification code C₁ for
a control channel formed by the radio base station 61₁
and identification codes C₃ and C₄ for control
15 channels (hereinafter, referred to as overlap control
channels) assigned to the microcell 63 and the
picocell 64 embodying the overlap zones, via the
communication link 71₁ and the transmission device
70₁. As indicated by a hatched area in Fig. 10, the
20 base station control device 69₁ incorporates, in the
announcement information, the identification codes C₁
and C₃ - C₄ for the control channel and the overlap
control channels, respectively, such that a series of
the identification codes C₄, C₃ and C₁ are arranged
25 according to respective positions in the hierarchy.
The wait enabled level and the wait disabled level are
also included in the announcement information as in
the conventional system.

The control unit 77₁ of the mobile
30 station 65₁ effects the measurement process and the
zone determination process as in the conventional
system. In the zone determination process, a
determination as to whether the format of the
announcement information received via the control
35 channel subject to the measurement of the electric
field intensity L₂ is the same as the conventional
format shown in Fig. 2 is made, depending on whether

1 the above-described series of the identification codes
is included in the announcement information ((1) of
Fig. 9).

5 If the format of the announcement
information is found to be the same as the
conventional format, the control unit 77_1 performs the
zone determination process in accordance with the same
procedure as observed in the conventional system
before proceeding to a wait state ((2) of Fig. 9).

10 If the format of the announcement
information is not found to be the same as the
conventional format, the control unit 77_1 stores the
series of the identification codes C_4 , C_3 and C_1 in a
reserved area (hereinafter, referred to as a selected
15 candidate zone register) in the main memory ((3) of
Fig. 9). The control unit 77_1 sequentially refers to
the identification codes C_4 , C_3 and C_1 and measures
the electric field intensity L_3 of the overlap control
channels and the control channel corresponding to the
20 respective identification codes ((4) of Fig. 9). The
control unit 77_1 then compares the measured electric
field intensity with the wait enabled level L_{th}
received in the announcement information via the
channel subject to the measurement ((5) of Fig. 9).

25 If the electric field L_3 is found to
exceed the wait enabled level L_{th} , the control unit
 77_1 retains the relevant identification code in the
selected candidate zone register. If the opposite is
the case, the relevant identification code is removed
30 ((6) of Fig. 9).

When the control unit 77_1 has processed
all the identification codes stored in the candidate
zone register, a determination is made as to whether
or not the selected candidate zone register contains
35 any identification code ((7) of Fig. 9). When the
determination in (7) gives a negative answer, the
control unit 77_1 performs the zone determination

1 process in accordance with the conventional procedure
before proceeding to a wait state ((8) of Fig. 9).

When the determination in (7) gives a
positive answer, the control unit 77₁ designates an
5 overlap control channel (or a control channel)
specified by the identification code stored earliest
in the selected candidate zone register as a control
channel for a radio zone in which the mobile station
65₁ is to receive the communication service, and
10 proceeds to be set up for a wait in the designated
control channel ((9) of Fig. 9).

Thus, in the system described above,
the mobile stations 65₁ - 65_N give a priority to the
microcell 63 over the radio zone 62₁, and give a
15 priority to the picocell 64 over the microcell 63, in
selecting a wait zone. In contrast with the
conventional system in which the wait zone is selected
simply in accordance with the order of electric field
intensity of the associated control channels, the
20 embodiments that correspond to the invention described
in claims 2, 3 and 14 - 16 ensure that the mobile
station can wait in the most appropriate zone than the
conventional system.

In the foregoing description, it is
25 assumed that the mobile stations 65₁ - 65_N are
implemented by the mobile station described in claim
16. However, mobile stations according to different
embodiments may also be employed.

Fig. 11 is a flowchart of an operation
30 of the mobile communication system according to
embodiments that correspond to the invention described
in claims 4 - 9, 14 and 15.

A description will now be given, with
reference to Figs. 1 and 11, of the operation of the
35 system according to embodiments that correspond to
invention described in claims 4 - 7. For the sake of
simplicity of the description that follows, it is

1 assumed that the mobile station 65₁ is located in the
same location assumed in the description of the
related art.

5 In the absence of overlap zones such as
a microcell 63, a picocell 64 and the like at
respective locations in a radio zone formed by the
radio base station 61₁, the base station control
device 69₁ of the radio base station 61₁ transmits the
announcement information having the same format as
10 that of the conventional announcement information as
shown in Fig. 2, via the transmission and reception
unit 68₁, the common antenna equipment unit 67₁ and
the antenna 66₁.

15 If there are overlap zones, the base
station control device 69₁ is provided by a control
station (not shown) with an identification code C₁ for
a control channel assigned to the radio base station
61₁, identification codes C₃ and C₄ for overlap
control channels assigned to the microcell 63 and the
20 picocell 64 embodying the overlap zones, and numerals
P₁, P₃ and P₄ indicating the hierarchical order of the
radio zone 62₁, the microcell 63 and the picocell 64,
via the communication link 71₁ and the transmission
device 70₁. The numerals will be simply referred to
25 as the order of priority. For the sake of simplicity
of the description, it is assumed that the radio zone
62₁ has the order of priority P₁ = 0, the microcell 63
P₃ = 1 and the picocell 64 P₄ = 2.

30 As indicated by a hatched area in Fig.
12, the base station control device 69₁ incorporates,
in the announcement information, the identification
codes C₁ and C₃ - C₄, and the orders of priority P₁,
P₃ and P₄ such that a resultant series of
identification information C₁, P₁, C₃, P₃, C₄ and P₄
35 show correspondences between the individual channels
and the order of priority associated therewith. The
wait enabled level and the wait disabled level are

1 also included in the announcement information as in
the conventional system.

5 The control unit 77_1 of the mobile
station 65_1 effects the measurement process and the
zone determination process as in the conventional
system. In the zone determination process, a
determination as to whether the format of the
announcement information received via the control
channel subject to the measurement of the electric
10 field intensity L_2 is the same as the conventional
format shown in Fig. 2 is made, depending on whether
the above-described series of the identification
information is included in the announcement
information ((1) of Fig. 11).

15 If the format of the announcement
information is found to be the same as the
conventional format, the control unit 77_1 performs the
zone determination process in accordance with the same
procedure as observed in the conventional system
20 before proceeding to a wait state ((2) of Fig. 11).

If the format of the announcement
information is not found to be the same as the
conventional format, the control unit 77_1 stores the
series of the identification information $C_1, P_1, C_3,$
25 P_3, C_4 and P_4 in the selected candidate zone register
in the main memory ((3) of Fig. 11). The control unit
 77_1 sorts the combinations of the identification codes
and the orders of priority stored in the selected
candidate zone register, in the ascending order of
30 priority. Once this sorting is done, all the orders
of priority are removed from the register, resulting
in the series of identification information consisted
only of the identification codes being stored in the
selected candidate zone register ((a) of Fig. 11).

35 The control unit 77_1 sequentially
refers to the identification codes C_4, C_3 and C_1 and
measures the electric field intensity L_3 of the

1 overlap control channels and the control channel
corresponding to the respective identification codes
((4) of Fig. 11). The control unit 77₁ then compares
the measured electric field intensity with the wait
5 enabled level L_{th} received in the announcement
information via the channel subject to the measurement
((5) of Fig. 11).

When the result of the comparison is
available, the control unit 77₁ then enters a wait
10 state in accordance with the same procedure as
observed in the embodiment that corresponds to the
invention described in claim 2. The steps subsequent
to (5) of Fig. 11 are designated by the same reference
numerals (6) - (9) as the corresponding steps of Fig.
15 9, and the description thereof is omitted.

According to embodiments that
correspond to the invention described in claims 4 - 9,
14 and 15, as long as the correspondences between the
identification codes and the respective orders of
20 priority are established, it is possible for the radio
base stations 61₁ - 61₄ to transmit identification
information as part of the announcement information
irrespective of the order of priority. Accordingly, a
flexible operation of the radio base stations 61₁ -
25 61₄ allowing addition of radio zones or reforming is
enabled. As in the embodiment that corresponds to the
invention described in claims 2 and 3, it is possible
for the mobile stations 65₁ - 65₄ to give a priority
to the microcell 63 over the radio zone 62₁ and to
30 give a priority to the picocell 64 over the microcell
63, in selecting a wait zone.

According to the embodiment that
corresponds to the invention described in claims 4 -
9, 14 and 15, the series of identification information
35 (C₁, P₁, C₃, P₃, C₄, P₄) stored in the selected
candidate zone register is sorted in the ascending
order of the priority, and then the identification

1 information consisting only of the identification
codes are retained in the selected candidate zone
register. An alternative procedure may be to retain
the orders of priority in the selected candidate zone
5 register so that the identification code with the
highest priority may be referred to in selecting a
wait zone.

As shown in Fig. 12, according to the
embodiment that corresponds to the invention described
10 in claims 4 - 9, 14 and 15, the radio base station 61₁
transmits, as part of the announcement information,
the order of priority P₁ for the radio zone 62₁ in
relation to the identification code C₁ for the radio
zone 62₁. However, if the mobile station (65₁ - 65_N)
15 is capable of identifying the relative order of
priority of the radio zone 62₁ with respect to other
radio zones (for example, the microcell 63 and the
picocell 64), or if it is evident that the mobile
station (65₁ - 65_N) should be set up for a wait in the
20 radio zone at the top of the hierarchy or the radio
zone at the bottom thereof, the order of priority may
not be included in the announcement information.
Accordingly, the volume of the announcement
information is reduced so that the system flexibility
25 with respect to modifications etc. thereof can be
improved.

A description will now be given, with
reference to Figs. 1 and 11, of the operation of the
system according to an embodiment that corresponds to
30 the invention described in claims 8 and 9. For the
sake of simplicity of the description that follows, it
is assumed that the mobile station 65₁ is located in
the same location assumed in the description of the
related art.

35 In the absence of overlap zones such as
a microcell 63, a picocell 64 and the like at
respective locations in a radio zone formed by the

1 radio base station 61_1 , the base station control
device 69_1 of the radio base station 61_1 transmits the
announcement information having the same format as
5 shown in Fig. 2, via the transmission and reception
unit 68_1 , the common antenna equipment unit 67_1 and
the antenna 66_1 .

If there are overlap zones, the base
station control device 69_1 is provided by a control
10 station (not shown) with an identification code C_1 and
an associated order of priority P_1 for a control
channel formed by the radio base station 61_1 ,
identification codes C_3 and C_4 for overlap control
channels assigned to the microcell 63 and the picocell
15 64 embodying the overlap zones, the order of the
identification codes C_3 and C_4 not being related to
the associated orders of priority. The resultant
series of identification information P_1 , C_1 , C_4 and C_3
20 incorporated in the announcement information is
indicated by a hatched area in Fig. 13. The wait
enabled level and the wait disabled level are also
included in the announcement information as in the
conventional system. For the sake of simplicity of
the description, it is assumed that the order of
25 priority $P_1 = 0$.

The control unit 77_1 of the mobile
station 65_1 effects the measurement process and the
zone determination process as in the conventional
system. In the zone determination process, a
30 determination is made as to whether the format of the
announcement information received via the control
channel in which the electric field intensity L_2 is
measured is the same as the conventional format shown
in Fig. 2, depending on whether the above-described
35 series of the identification information is included
in the announcement information ((1) of Fig. 11).

If the format of the announcement

1 information is found to be the same as the
conventional format, the control unit 77₁ performs the
zone determination process in accordance with the same
procedure as observed in the conventional system
5 before proceeding to a wait state ((2) of Fig. 11).

If the format of the announcement
information is not found to be the same as the
conventional format, the control unit 77₁ extracts the
order of priority P₁ and the identification code C₁
10 from the series of identification information P₁, C₁,
C₄ and C₃ and stores the extracted information in the
selected candidate zone register in the main memory
((3) of Fig. 11). The control unit 77₁ measures the
electric field intensity L₂ of the overlap control
15 channels specified by the identification codes C₄ and
C₃ and stores the identification codes C₄ and C₃, and
the orders of priority thereof in the selected
candidate zone register. A similar step as above is
performed in the event that any additional
20 identification code is received in the form of the
announcement information (an identification code that
is repeated is not subject to the above step).

When the identification codes and the
associated orders of priority for the radio zones that
25 are candidates for a wait zone have been stored in the
selected candidate zone register, the control unit 77₁
performs the same steps ((a), (4) - (9) of Fig. 11) as
performed in the embodiment that corresponds to the
invention described in claims 4 - 7, before proceeding
30 to a wait state.

According to the embodiment described
above, the announcement information may not include
the orders of priority of all the microcells and
picocells in order for the control unit 77₁ of the
35 mobile station 65₁ to specify the control channel for
the radio zone in which the mobile station 65₁ is
actually located before proceeding to a wait state.

1 Therefore, an advantage of the
embodiment that corresponds to the invention described
in claims 8 and 9 over the embodiment that corresponds
to the invention described in claims 4 - 7 is that the
5 transmission efficiency of the control channel is
increased and flexibility with respect to different
modes of service is available.

 While the identification codes in the
foregoing embodiments are for identifying individual
10 control channels or overlap control channels, the
present invention is not limited to such a
constitution. The mobile station ($65_1 - 65_N$) may use
alternative identification information (zone
identification information) for identifying radio
15 zones (such as the picocell 64, the microcell 63, the
radio zone 62_1), instead of control channels
associated therewith, included in the announcement
information, in order to determine a radio zone for
entry.

20 In the alternative approach described
above, information specifying overlap control channels
and control channels that correspond to the zone
identification information may be stored in the form
of a table in an area reserved in a main memory of the
25 control unit $77_1 - 77_N$, or may be provided separately
(for example, as part of the announcement information)
in accordance with the radio channel setting control
executed in relation to the radio base stations $61_1 -$
 61_4 .

30 Fig. 14 is a flowchart of an operation
of the mobile communication system according to an
embodiment that corresponds to the invention described
in claims 10, 14 and 15.

 A description will now be given, with
35 reference to Figs. 1 and 14, of the operation
according to an embodiment that corresponds to the
invention described in claim 10. For the sake of

1 simplicity of the description that follows, it is
assumed that the mobile station 65₁ is located in the
same location assumed in the description of the
related art.

5 In the absence of overlap zones at
respective locations in a radio zone formed by the
radio base station 61₁, the base station control
device 69₁ of the radio base station 61₁ transmits the
announcement information having the same format as
10 that of the conventional announcement information as
shown in Fig. 2, via the transmission and reception
unit 68₁, the common antenna equipment unit 67₁ and
the antenna 66₁.

If there are overlap zones, the base
15 station control device 69₁ is provided by a control
station (not shown) with an identification code C₁ for
a control channel assigned to the radio base station
61₁, identification codes C₃ and C₄ for overlap
control channels assigned to the microcell 63 and the
20 picocell 64 embodying the overlap zones, orders of
priority P₁, P₃ and P₄ indicating the hierarchical
order of the radio zone 62₁, the microcell 63 and the
picocell 64, wait enabled levels L_{th1}, L_{th2} and L_{th3}
and the wait disabled levels l_{th1}, l_{th3} and l_{th4}, via
25 the communication link 71₁ and the transmission device
70₁. For the sake of simplicity of the description,
it is assumed that the radio zone 62₁ has the order of
priority P₁ = 0, the microcell 63 P₃ = 1 and the
picocell 64 P₄ = 2.

30 As indicated by a hatched area in Fig.
15, the base station control device 69₁ incorporates,
in the announcement information, the orders of
priority P₁, P₃ and P₄, the identification codes C₁,
C₃ and C₄, the wait enabled levels L_{th1}, L_{th2} and L_{th3}
35 and the wait disabled levels l_{th1}, l_{th3} and l_{th4},
resulting in series of identification information (P₁,
C₁, L_{th1} and l_{th1}) ... (P₄, C₄, L_{th4} and l_{th4}) each

1 corresponding to the radio zone.

The control unit 77_1 of the mobile station 65_1 effects the measurement process and the zone determination process as in the conventional system. In the zone determination process, a determination as to whether the format of the announcement information received via the control channel subject to the measurement of the electric field intensity L_2 is the same as the conventional format shown in Fig. 2 is made, depending on whether the above-described series of the identification information is included in the announcement information ((1) of Fig. 14).

If the format of the announcement information is found to be the same as the conventional format, the control unit 77_1 performs the zone determination process in accordance with the same procedure as observed in the conventional system before proceeding to a wait state ((2) of Fig. 14).

If the format of the announcement information is not found to be the same as the conventional format, the control unit 77_1 stores the series of the identification information (P_1, C_1, L_{th1} and l_{th1}) ... (P_4, C_4, L_{th4} and l_{th4}) included in the announcement information in the selected candidate zone register (A) of Fig. 14). The control unit 77_1 sorts the combinations of the orders of priority, the identification codes, the wait enabled levels and the wait disabled levels stored in the selected candidate zone register, in the ascending order of priority. Once this sorting is done, all the orders of priority are removed from the register ((a) of Fig. 14), resulting in the series of identification information consisted of the identification codes, the wait enabled levels and the wait disabled levels being stored in the selected candidate zone register.

The control unit 77_1 sequentially

1 refers to the identification codes C_4 , C_3 and C_1 , and
wait enabled levels L_{th4} , L_{th3} and L_{th1} arranged in
the ascending order of priority so as to measure the
electric field intensity L_3 of the overlap control
5 channels and the control channel corresponding to the
respective identification codes ((4) of Fig. 14). The
control unit 77_1 then compares the measured electric
field intensity with the wait enabled level L_{th} that
corresponds to the measured channel ((5) of Fig. 14).

10 When the result of the comparison is
available, the control unit 77_1 then enters a wait
state in accordance with the same procedure observed
in the embodiment that corresponds the invention
described in claim 4. The steps subsequent to (5) of
15 Fig. 14 are designated by the same reference numerals
(6) - (9) as the corresponding steps of Fig. 9, and
the description thereof is omitted.

According to the embodiment that
corresponds to the invention described in claim 10,
20 the mobile stations $65_1 - 65_N$ give a priority to the
radio zone having a greater order of priority, in
selecting a wait zone. The threshold level of the
electric field intensity that serves as a criteria
associated with each radio zone for selection of the
25 wait zone can be dynamically (or statically) set under
the control of the radio base station.

Accordingly, the geographical
distribution (number) of the mobile stations set up
for a wait in the radio zones 62_1 and 62_2 , the
30 microcell 63 and the picocell 64 can be properly
established. Also, the hierarchy of radio zones can
be properly established. As in the embodiment that
corresponds to the invention described in claim 2, the
mobile stations $65_1 - 65_N$ can give a priority to the
35 microcell 63 over the radio zone 62_1 and give a
priority to the picocell 64 over the microcell 63, in
selecting a wait zone.

1 While the embodiment described above is
constructed such that the series of information (P_1 ,
2 C_1 , L_{th1} and l_{th1}) ... (P_4 , C_4 , L_{th4} and l_{th4}) is
sorted according to the ascending order (the
5 descending order) of the order of priority, so that
the identification codes, the wait enabled levels and
the wait disabled levels are retained in the register,
the orders of priority may not be removed from the
register and may be referred to in selecting a wait
10 zone.

Fig. 16 is a flowchart of an operation
of a system according to an embodiment that
corresponds to the invention described in claims 11,
12, 14 and 15.

15 A description will now be given, with
reference to Figs. 1 and 16, of an operation of a
mobile communication system according to an embodiment
that corresponds to the invention described in claims
11 and 12.

20 In the absence of overlap zones at
respective locations in a radio zone formed by the
radio base station 61_1 , the base station control
device 69_1 of the radio base station 61_1 transmits the
announcement information having the same format as
25 that of the conventional announcement information as
shown in Fig. 2, via the transmission and reception
unit 68_1 , the common antenna equipment unit 67_1 and
the antenna 66_1 .

 If there are overlap zones, the base
30 station control device 69_1 is provided by a control
station (not shown) with an identification code C_1 for
a control channel formed by the radio base station
 61_1 , identification codes C_3 and C_4 for overlap
control channels assigned to the microcell 63 and the
35 picocell 64 embodying the overlap zones, orders of
priority P_1 , P_3 and P_4 indicating the hierarchical
order of the radio zone 62_1 , the microcell 63 and the

1 picocell 64, corrected values Δ_1 , Δ_2 and Δ_3 indicating
the enabled levels in the form of relative levels with
respect to a predetermined reference level L_0 and the
wait disabled levels l_{th1} , l_{th3} and l_{th4} , via the
5 communication link 71_1 and the transmission device
 70_1 . For the sake of simplicity of the description,
it is assumed that the radio zone 62_1 has the order of
priority $P_1 = 0$, the microcell 63 $P_3 = 1$ and the
picocell 64 $P_4 = 2$.

10 As indicated by a hatched area in Fig.
17, the base station control device 69_1 incorporates,
in the announcement information, the identification
codes C_1 , C_3 and C_4 , the orders of priority P_1 , P_3 and
 P_4 , the corrected values Δ_1 , Δ_2 and Δ_3 and the wait
15 disabled levels l_{th1} , l_{th3} and l_{th4} , resulting in
series of identification information (P_1 , C_1 , Δ_1 and
 l_{th1}) ... (P_4 , C_4 , Δ_4 and l_{th4}) each corresponding to
the radio zone.

The control unit 77_1 of the mobile
20 station 65_1 effects the measurement process and the
zone determination process as in the conventional
system. In the zone determination process, a
determination as to whether the format of the
announcement information received via the control
25 channel subject to the measurement of the electric
field intensity L_2 is the same as the conventional
format shown in Fig. 2 is made, depending on whether
the above-described series of the identification
information is included in the announcement
30 information ((1) of Fig. 16). If the format of the
announcement information is found to be the same as
the conventional format, the control unit 77_1 performs
the zone determination process in accordance with the
same procedure as observed in the conventional system
35 before proceeding to a wait state ((2) of Fig. 16).

If the format of the announcement
information is not found to be the same as the

1 conventional format, the control unit 77₁ stores the
series of the identification information (P_1 , C_1 , Δ_1
and l_{th1}) ... (P_4 , C_4 , Δ_4 and l_{th4}) included in the
announcement information in the selected candidate
5 zone register. The control unit 77₁ sorts the
combinations of the orders of priority, the
identification codes, the corrected values and the
wait disabled levels stored in the selected candidate
zone register, in the ascending order of priority.
10 Once this sorting is done, all the orders of priority
are removed from the register, resulting in the series
of identification information consisted of the
identification codes, the corrected values and the
wait disabled levels being stored in the selected
15 candidate zone register ((A) of Fig. 16).

The control unit 77₁ sequentially
refers to the identification codes C_4 , C_3 and C_1 , and
corrected values Δ_1 , Δ_2 and Δ_3 arranged in the
ascending order of priority so as to measure the
20 electric field intensity L_3 of the overlap control
channels and the control channel corresponding to the
respective identification codes ((4) of Fig. 16). The
control unit 77₁ then compares the measured electric
field intensity with a sum of the corrected value Δ
25 for the measured channel and the reference value L_0
((5) of Fig. 16).

When the result of the comparison is
available, the control unit 77₁ then enters a wait
state in accordance with the same procedure observed
30 in the embodiment that corresponds to the invention
described in claim 4. The steps subsequent to (5) of
Fig. 16 are designated by the same reference numerals
(6) - (9) as the corresponding steps of Fig. 14, and
the description thereof is omitted.

35 According to the embodiment described
above, the corrected values smaller than the values of
the wait enabled levels are included in the

1 announcement information in place of the wait enabled
levels. The mobile stations $65_1 - 65_N$ can give a
priority to the radio zone having a greater order of
priority, in selecting a wait zone.

5 Accordingly, the transmission
efficiency of the control channel can be maintained at
a high level. The geographical distribution (number)
of the mobile stations set up for a wait in the radio
zones 62_1 and 62_2 , the microcell 63 and the picocell
10 64 can be properly established. Also, the hierarchy
of radio zones can be properly established.
The mobile stations $65_1 - 65_N$ can give a priority to
the microcell 63 or the picocell 64 over the radio
zone 62_1 , in selecting a wait zone.

15 While the embodiment described above is
constructed such that the series of information (P_1 ,
 C_1 , Δ_1 and l_{th1}) ... (P_4 , C_4 , Δ_4 and l_{th4}) is sorted
according to the ascending order (the descending
order) of the order of priority so that the
20 identification codes, the corrected values and the
wait disabled levels are retained in the register, the
orders of priority may not be removed from the
register and may be referred to in selecting a wait
zone.

25 The embodiment described above is
constructed such that the radio base station transmits
the corrected values associated with all the
microcells and picocells formed within the radio zone
of that radio base station. Alternatively, for
30 example, the radio base stations each forming the
radio zone, the microcell or the picocell may transmit
only the corrected value associated with its own radio
zone. In such a case, the mobile station is expected
to perform the determination step ((5) of Fig. 16) by
35 acquiring the corrected value from the individual
control channels subject to measurement of the
electric field intensity.

1 Although no description is given of a
process related to the wait disabled level in the
embodiments that correspond to the invention described
in claims 10 - 12, the wait disabled level may be
5 employed as a criteria in a conventional determination
for determining whether or not the mobile station
should exit a wait state.

 Previous to the determination process,
the mobile station may remove, from the selected
10 candidate zone register, wait disabled levels other
than that of the control channel (or the overlap
control channel) in which the mobile station is set up
for a wait.

 In the foregoing embodiments,
15 comparison of the measured electric field intensity
with the wait enabled level is conducted in the
ascending order of priority assigned to the control
channels that are specified by the identification
codes stored in the candidate zone register or the
20 selected candidate zone register, so that the control
channel (or the overlap control channel) for which it
is found that the measured electric field intensity
exceeds the wait enabled level is selected as the
control channel in which to wait. Alternatively, the
25 electric field intensity of the control channels is
first measured irrespective of the order of priority
thereof, and then comparisons are made in the
ascending order of priority.

 Fig. 18 is a flowchart of an operation
30 of a mobile communication system according to an
embodiment that corresponds to the invention described
in claims 13 - 15.

 A description will now be given, with
reference to Figs. 1 and 17, of an operation of a
35 mobile communication system according to an embodiment
that corresponds to the invention described in claim
13.

1 The inventive feature of this system
consists in the measuring process. The other
processes including the zone entry process are the
same as the corresponding processes in the embodiments
5 described so far, and the description thereof is
omitted.

Those processes of Fig. 18 that are
identical to the corresponding processes of Fig. 3 are
designated by the same reference numerals, and the
10 description thereof is omitted.

Upon a power-on, the control unit 77_1
of the mobile station 65_1 measures sequentially the
electric field intensity L_1 of the control channels
registered in the control table channel by controlling
15 the transmission and reception unit 74_1 ((1) of Fig.
18). A determination is then made as to whether or
not the measured electric field intensity is greater
than a predetermined threshold level L_{th} ((2) of Fig.
18).

20 The control unit 77_1 registers the
control channels for which a determination that the
measured electric field intensity is greater than the
threshold level L_{th} is obtained, in the candidate zone
register, in relation to the electric field intensity
25 ((3) of Fig. 18).

The control unit 77_1 starts the zone
entry determination process without measuring the
electric field intensity of the other control channels
registered in the control channel table.

30 In those steps of the zone entry
determination process which steps are started when it
is found that the format of the announcement
information differs from the conventional format, all
the control channels, specified by the identification
35 information provided in the order of priority or
provided coupled to information indicating the
respective order of priority, are subject to the

1 measurement of the electric field intensity and also
to the comparison for determining whether or not the
measured electric field intensity exceeds the wait
enabled level.

5 According to the embodiment described
above, the time required for the mobile station ($65_1 -$
 65_N) to enter a wait state upon a power-on is reduced.
Therefore, it is ensured that the service can be
provided promptly upon a power-on or upon an exchange
10 of a battery.

A description will now be given, with
reference to Figs. 1, 9, 11, 14, 16 and 18, of an
operation of a mobile communication system according
to an embodiment that corresponds to the invention
15 described in claims 14 and 15.

The difference between this embodiment
and the earlier embodiments consists in the
measurement process and the zone determination
process.

20 In the measurement process according to
this embodiment, the control unit 77_1 allows the
previously measured electric field intensity for a
given channel to be stored in the candidate zone
register in relation to its electric field intensity.

25 In further accordance with this
embodiment, when the control unit 77_1 measures the
electric field intensity L_2 or L_3 ((7) of Fig. 3, (4)
of Fig. 9, (4) of Fig. 11, (4) of Fig. 14 and (4) of
Fig. 16), a determination is made as to whether or not
30 the control channel subject to the measurement is
stored in the candidate zone register. If an
affirmative answer is given in the determination, the
measurement of that control channel is omitted. The
electric field intensity already stored in the target
35 zone register for that control channel is regarded as
the electric field intensity L_2 or L_3 .

According to the above-described

1 embodiment, it is possible to reduce the total number
of control channels to be subjected to the measurement
of its electric field intensity before the mobile
station enters a wait state. Therefore, the operating
5 efficiency of the mobile station is increased and the
quality of the service is improved.

As shown in Figs. 9, 10, 13 and 15,
according to the foregoing embodiments, a
determination as to whether or not the electric field
10 intensity exceeds the wait enabled level is made for
the control channels that correspond to all the
identification codes stored in the selected candidate
zone register. An alternative approach indicated by
the chain lines in Figs. 9, 10, 13 and 15 is that upon
15 a determination that the electric field intensity of
any channel (radio zone) exceeds the wait enabled
level, the mobile station immediately is set up for a
wait in that control channel (radio zone) so that the
mobile station can receive the communication service.

20 While the identification information
for overlapping zones adjacent to the radio zone
formed by a given radio base station is not
transmitted by the given radio base station, according
to the foregoing embodiments, the identification
25 information for the adjacent zones may be transmitted
as long as the relative orders of priority of the
adjacent radio zones with respect to the radio zone
formed by the given radio base station are recognized
properly by the mobile station.

30 In the foregoing embodiments, various
information is arranged in the announcement
information in the ascending order of priority, the
announcement information is not limited to such a
construction. For example, the various information
35 may be arranged in the descending order or in a
predetermined format corresponding to the order of
priority.

1 Also, in the foregoing embodiments, the
announcement information includes the channel numbers
of the control radio channels assigned to the
respective radio zones (radio base stations) and used
5 to transmit the announcement information. However,
the channel numbers may be replaced by a radio
frequency in case the radio channel is formed by a
single radio frequency as in the case of an analog
mobile communication system, instead of being
10 constituted according to a time division system such
as the TDMA system.

 Further, in the foregoing embodiments,
digital transmission of the announcement information
is effected by utilizing a spare field not reserved
15 under a given frame format, the present invention is
not limited to such a construction. For example, if
the size of the spare field is not satisfactorily
large, the announcement information may be transmitted
in multiframe. The announcement information may be
20 transmitted in a plurality of frames, either frame by
frame or in dividends thereof, as long as the mobile
station can properly receive the announcement
information.

 While the foregoing embodiments are
25 constructed such that the announcement information is
transmitted via the control radio channel, the present
invention can be applied to various systems
irrespective of the radio channel setting control
method and the radio transmission method.

30 Reference is made to Fig. 20 and a
description will now be given of embodiments of the
invention directed to resolving the second aspect of
the problem with the conventional mobile communication
system. According to the invention described below,
35 each of a plurality of base stations forming
overlapping zones and constituting a mobile
communication system is assigned an order of priority.

1 A mobile station requests a message channel from the
base station having a relatively high order of
priority so that a call using that base station is
enabled.

5 Referring to Fig. 20, a zone 221 formed
by a base station 201 and a zone 222 formed by a base
station 202 are adjacent to each other. In the zone
221 are provided a base station 203 having a smaller
transmission power than the base station 201 and
10 forming a zone 223 and a base station 204 having a
smaller transmission power than the base station 203
and forming a zone 224 smaller than the zone 223. A
mobile station 205 is movable in an area comprising
the zone 221, the zone 222, the zone 223 and the zone
15 224.

Fig. 32 shows a hardware construction
of a base station assumed in the following
description, and Fig. 33 shows a hardware construction
of a mobile station assumed in the following
20 description.

Referring to Fig. 32, a
transmission/reception unit 101 of a base station
includes TRX shelves 106, an RF distribution/synthesis
unit 107, an amplifier unit 108 and an antenna 108. A
25 control unit 102 manages announcement information set
up in the base station by a control center 104 via an
interface unit 103. The control unit 102 transmits
the announcement information to a transmitter/receiver
(TRX) within the TRX shelf 106 at a timing provided by
30 the oscillator 105. The transmitter/receiver which
has received the announcement information transmits
the announcement information to the mobile station via
the RF distribution/synthesis unit 107, the amplifier
unit 108 and the antenna 109.

35 A request for a message channel
issued by the mobile station originating a call or
receiving a call is received by the

1 transmitter/receiver in the TRX shelf 106 via the
antenna 109, the amplifier unit 108 and the RF
distribution/synthesis unit 107. The information
received by the transmitter/receiver is transmitted to
5 the control center 104 under the control of the
control unit 102 so that communication via the fixed
network 105 is set up. By definition, a shelf is a
box for storing the transmitter/receiver.

The transmission/reception unit 101
10 corresponds to a transmission/reception unit 306 shown
in Fig. 19 illustrating the principle of the present
invention directed to resolving the second aspect of
the problem with the conventional mobile communication
system. The control unit 102 corresponds to a data
15 control unit 307 shown in Fig. 19. The description of
the transmission/reception unit 306 and the data
control unit 307 will be given later.

Referring to Fig. 33, a
transmission/reception unit 501 of a mobile station
20 includes a TDMA (time division multiple access)
circuit 504, a modulator 510, a demodulator 503,
receivers 508 and 509, a common antenna 507, and
antennas 505 and 506. The announcement information
from the base station is received by the receiver 508
25 via the antenna 505 or received by the receiver 509
via the antenna 506 and the common antenna 507. The
signal demodulated by the demodulator 503 is processed
by the TDMA circuit 504. The control unit 502 selects
the base station from which the mobile station is to
30 request a message channel, based on the order of
priority of the base stations contained in the
announcement information and based on the reception
level in the perch channels provided for the
respective base station.

35 A request for a message channel
occurring when a call is originated or when a call is
received is transmitted to the TDMA circuit 504 under

1 the control of the control unit 502. The request is
processed by the TDMA circuit 504 and then modulated
by the modulator 510. The modulated request is
transmitted to the target base station via the common
5 antenna 507 and the antenna 506.

The transmission/reception unit 501
corresponds to an announcement information receiving
unit 309 and a transmission unit 310 described later.
The control unit 502 corresponds to a message channel
10 control unit 308, an announcement information storage
unit 311 and a reception level measuring unit 312
described later.

Fig. 19 illustrates the principle of
the present invention directed to resolving the second
15 aspect of the problem with the conventional mobile
communication system. The base station 201 includes
the data control unit 307 and the
transmission/reception unit 306. The base station 201
transmits announcement information to mobile stations
20 and assigns a message channel to a requesting mobile
station.

The data control unit 307 manages and
controls the order of priority assigned to the base
station 201 and other base stations associated with
25 the base stations 201. The data control unit 307 also
controls assignment of a message channel responsive to
a request for a message channel from a mobile station,
so as to set up a call. A request for a message
channel could occur when switching from one message
30 channel to another occurs during a communication. A
request for a message channel could also occur when a
mobile station originates a call or receives a call.
The transmission/reception unit 306 provides an
interface for all the signals controlled by the data
35 control unit 307. The base stations 202, 203 and 204
have the same construction and function the same way
as the base station 201 so that the description

1 thereof is omitted.

 Referring again to Fig. 19, a mobile
station 205 comprises the message channel control unit
308, the announcement information receiving unit 309,
5 the transmission unit 310, the announcement
information storage unit 311 and the reception level
measuring unit 312.

 The message channel control unit 308
operates to select a base station to which a request
10 for a message channel is to be issued, based on the
order of priority of the base stations included in the
announcement information from the base station (one of
the base stations 201, 202, 203 and 204), and based on
the reception level in the perch channels provided for
15 the respective base stations (the base stations 201,
202, 203 and 204). The announcement information
receiving unit 309 operates to receive the
announcement information from the base station. The
transmission unit 310 operates to transmit a request
20 for a message channel to the base station selected by
the message channel control unit 308. The
announcement information storage unit 311 stores the
announcement information received by the announcement
information receiving unit 309. The reception level
25 measuring unit 312 reads the announcement information
stored in the announcement information storage unit
311 when a request for a message channel is issued to
the base station, and measures the reception level of
the perch channels provided for the respective base
30 stations in the descending order of priority such that
the reception level in the perch channel having the
highest priority is measured first. The reception
level measuring unit 312 transmits the measured
reception level to the message channel control unit
35 308.

 Figs. 21A and 21B illustrate the
principle according to which a mobile station issues a

1 request for a message channel to a base station in the
mobile communication system of Fig. 19. Fig. 21A
shows how the announcement information is delivered,
and Fig. 21B shows the principle of the flow of the
5 call origination operation according to the present
invention.

An outline of the call request
operation according to the present invention will now
be given. It is assumed that the mobile station 205
10 is located in the service area formed by the base
station 204 but is set up for a wait in the base
station 201. When the mobile station 205 issues a
call, the reception level measuring unit 312 of the
mobile station 205 measures the reception level of the
15 base stations 201, 202, 203 and 204 and determines
that the announcement information is to be received
from, for example, the base station 201 that provides
the highest reception level. It is assumed that the
reception levels measured by the reception level
20 measuring unit 312 are such that the base station 201,
the base station 202, the base station 203, the base
station 204 and the base station 202 have increasingly
lower reception levels in the stated order.

When the transmission/reception unit
25 306 of the base station 201 transmits the announcement
information managed by the data control unit 307, the
announcement information receiving unit 307 of the
mobile station 205 stores the received announcement
information in the announcement information storage
30 unit 311. The announcement information transmitted by
the base station could have the format as shown in
Fig. 22, Fig. 23 or Fig. 24. The announcement
information having the format of Fig. 22 includes the
order of priority assigned to the base station
35 transmitting the announcement information. The format
shown in Fig. 23 is such that the perch channel codes
corresponding to the base station which is the source

1 of the announcement information and corresponding to
the adjacent base stations are arranged in the
descending order (or the ascending order) of the
priority. The format shown in Fig. 24 is such that
5 each of the perch channel codes corresponding to the
source base stations and the adjacent base stations is
coupled to the associated order of priority.

The reception level measuring unit 312 of the mobile station originating a call measures the reception level of the perch channels provided for the base stations, in the descending order of the priority based on order of priority specified in the announcement information from the base station (step S1). The reception level measuring unit 312 transmits the reception level to the message channel control unit 308. It is assumed that the order of priority is such that the base station 204, the base station 203, the base station 201 and the base station 202 have increasingly lower priorities in the stated order.

20 Once the reception level in the perch
channel corresponding to the base station 204 is
received, the message channel control unit 308
determines that a request for a message channel is to
be issued to the base station 204 if the measured
25 reception level is equal to or exceeds a predetermined
threshold level. The message channel control unit 308
then issues a request for a message channel to the
base station 204 via the transmission unit 310 (S2).

A detailed description of call origination outlined above will now be given. Fig. 25 is a flowchart showing the flow of the call origination operation, and Fig. 26 shows a sequence of the call origination operation.

35 The reception level measuring unit 312
of the mobile station 205 measures the reception level
provided by the base stations (the base stations 201,
202, 203 and 204) forming the respective zones (steps

1 S201, S202, S203 and S204 of Fig. 26). It is assumed
that the measured reception levels are such that the
base station 202, the base station 204, the base
station 203 and the base station 201 have increasingly
5 higher reception levels in the stated order.
Accordingly, the message channel control unit 308
determines that the announcement information is to be
received from the base station 201.

Upon receipt of the announcement
10 information from the base station 201 (S205), the
announcement information receiving unit 309 of the
mobile station 205 causes the announcement information
to be stored in the announcement information storage
unit 311. The announcement information could have the
15 format as shown in Fig. 22, Fig. 23 or Fig. 24. The
announcement information having the format of Fig. 22
includes the order of priority assigned to the base
station transmitting the announcement information.
When the mobile station 205 receives the announcement
20 information having the format as shown in Fig. 22, the
mobile station 205 needs to acquire the announcement
information from the base stations other than the
source base station (the base station 201) that
transmitted the announcement information, in order to
25 learn the order of priority assigned to the base
stations adjacent to the source base station. The
format shown in Fig. 23 is such that the perch channel
codes corresponding to the source base station and the
adjacent base stations are arranged in the descending
30 order (or the ascending order) of the priority. The
format shown in Fig. 24 is such that each of the perch
channels codes corresponding to the source base
stations and the adjacent base stations is coupled to
the associated order of priority. It will now be
35 assumed that the mobile station 205 has received the
announcement information having the format of Fig. 23.

The message channel control unit 308

1 reads the announcement information from the
announcement information storage unit 311 so as to
learn the order of priority assigned to the base
stations (the base stations 201, 202, 203 and 204) and
5 a predetermined level of the reception level that
enables a request for a message channel. It is
assumed that the base station 202, the base station
201, the base station 203 and the base station 204
have the increasingly higher priorities. The
10 reception level measuring unit 312 reads the
announcement information from the announcement
information storage unit 311 so as to retrieve the
order of priority included in the announcement
information to be assigned to the respective perch
15 channels codes, each of the perch channel codes
corresponding to the associated base station. The
reception level measuring unit 312 then measures the
reception level of the perch channel corresponding to
the base station 204 having the highest priority
20 (S206).

The reception level measuring unit 312
transmits the measured reception level to the message
channel control unit 308. The message channel control
unit 308 determines whether the level is equal to or
25 exceeds a predetermined threshold level that enables a
request for a message channel. If it is determined
that level is equal to or exceeds the threshold level,
the mobile station acquires the announcement
information from the base station 204 (S207). If it
30 is determined that the level is below the threshold
level, the reception level measuring unit 312 measures
the reception level of the perch channel corresponding
to the base station 203 having the next highest order
of priority (S206). The reception level measuring
35 unit 312 repeats step S206 such that it successively
measures the reception level of the perch channel
provided for the respective base stations in the

1 descending order of priority, until the base station
that provides the reception level which is equal to or
exceeds the threshold level is found, or until all the
perch channels are subject to measurement.

5 When the user of the mobile station 205
performs an operation for originating a call (S208 in
Fig. 26 and S101 in Fig. 25) after S207, the message
channel control unit 308 determines whether the
announcement information from the base station 204
10 contains the order of priority of the base stations
(base stations 201, 202, 203 and 204) (S102).

When the announcement information
contains the order of priority (YES in S102) of the
base stations 201, 202, 203 and 204, the reception
15 level measuring unit 312 reads the announcement
information from the announcement information storage
unit 311 so as to retrieve the order of priority
assigned to the perch channels which are provided for
the base stations 201, 202, 203 and 204. The
20 reception level measuring unit 312 measures the
reception level of the perch channel corresponding to
the base station 204 having the highest priority. The
order of priority stored in the announcement
information storage unit 311 is such that the base
25 station 202 < the base station 201 < the base station
203 < the base station 204.

The reception level measuring unit 312
transmits the reception level in the perch channel
corresponding to the base station 204 to the message
30 channel control unit 308. The message channel control
unit 308 determines whether the reception level is
equal to or exceeds a predetermined threshold level
that enables a request for a message channel (S103).
If the message channel control unit 308 determines
35 that the reception level is equal to exceeds the
threshold level (YES in S103), the message channel
control unit 308 retrieves restriction information

If the message channel control unit 308 determines in step S103 that the reception level is below the threshold level (NO in S103), the reception level measuring unit 312 determines whether a perch channel corresponding to the base station having the next highest priority is available (S104). If no perch channel corresponding to the base station having the next highest priority is available (NO in S104), it is determined that the mobile station 205 cannot originate a call (S105) and is put in a wait state (S106). If a perch channel corresponding to the base station having the next highest priority is available (YES in S104), the reception level measuring unit 312 repeats steps S104 and S107 such that it successively measures (NO in S107) the reception level in the perch channels in the descending order of priority until the base station providing a reception level which is equal to or exceeds the threshold level is found (YES in S107) or until all the perch channels have been subject to measurement (NO in S104). If the message channel control unit 308 finds a base station that provides a reception level which is equal to or exceeds the threshold level (YES in S107), the message channel control unit 308 retrieves the restriction information from the announcement information stored in the announcement information storage unit 311 so as to determine if it is possible to originate a call in the zone formed by the base station found in S107 (S108). If it is determined that the order of priority of the base stations is not included in the announcement information (NO in S102), the message channel control unit 308 retrieves the restriction

1 information from the announcement information stored
in the announcement information storage unit 311 and
determines whether it is possible to originate a call
in the zone formed by the base station which is the
5 source of the stored announcement information (S108).

If it is determined that call
origination is disabled in the zone 224 formed by the
base station 204 (NO in S108), the mobile station 205
is put in a wait state (S109). If call origination is
10 enabled (YES in S108), the message channel control
unit 308 retrieves the restriction information from
the announcement information stored in the
announcement information storage unit 311 so as to
determine whether a restriction regarding a preferred
15 mobile station is imposed on the zone 224 formed by
the base station 204 (S110). A preferred mobile
station is a station which is given a precedence in
message channel assignment.

If it is determined that a restriction
20 regarding a preferred mobile station is imposed (YES
in S110) and if the mobile station 205 is a preferred
mobile station (YES in S111), the message channel
control unit 308 determines whether call origination
in the mobile station 205 is enabled (S112). If it is
25 determined that call origination is enabled (YES in
S112), the message channel control unit 308 determines
that a request for a message channel is to be issued
to the base station 204 and causes the transmission
unit 310 to transmit a request for a message channel
30 (S209). If it is determined that call origination is
disabled (NO in S112), the mobile station 205 is put
in a wait state (S113).

If a restriction regarding a preferred
mobile station is imposed (YES in S110) and if the
35 mobile station 205 is not a preferred mobile station
(NO in S111), the message channel control unit 308
determines whether a restriction is imposed on the

1 mobile station 205 (S114). If there is no restriction
(NO in S114), the message channel control unit 308
determines that a request for a message channel is to
be issued to the base station 204 and causes the
5 transmission unit 310 to transmit a request for a
message channel to the base station 204 (S209). If
there is a restriction (YES in S114), the mobile
station 205 is put in a wait state (S115).

If it is determined that no restriction
10 regarding a preferred mobile station is imposed (NO in
S110), the message channel control unit 308 determines
that a request for a message channel is to be issued
to the base station 204 and causes the transmission
unit 310 to transmit a request for a message channel
15 (S209).

When an unused message channel is
available in the base station 204 receiving the
request for a message channel, the base station 204
assigns a message channel to the mobile station 205
20 and transmits a channel assignment signal to the
mobile station (S210). When there is no message
channel available, the base station 204 notifies the
mobile station 205 that there is no message channel
available, thus putting the mobile station in a wait
25 state.

The mobile station 205 that has
received the channel assignment signal originates a
call to another mobile station (S116) and establishes
the assigned message channel with the base station 204
30 so as to start a call.

Referring to Fig. 20, a detailed
description will now be given of how a call incoming
to the mobile station 205 located in the service area
formed by the base station 203 and set up for a wait
35 in the base station 201 is processed according to the
mobile communication system of the present invention.
Reference is also made to Fig. 27, which shows the

1 flow of the call-incoming operation according to the
present invention, and Fig. 28, which shows the
sequence of the call-incoming operation.

5 The reception level measuring unit 312
of the mobile station 205 measures the reception level
provided by the base stations 201, 202, 203 and 204
forming the respective zones (steps S401, S402, S403
and S404 in Fig. 28). It is assumed that the
10 reception levels provided by the base stations 201,
202, 203 and 204 are such that the base station 202 <
the base station 204 < the base station 203 < the base
station 201, so that the message channel control unit
308 determines that the announcement information is to
15 be received from the base station 201 providing the
highest reception level.

The mobile station 205 has received the
announcement information from the base station 201
(S405), the announcement information receiving unit
309 causes the announcement information to be stored
20 in the announcement information storage unit 311. The
announcement information could have the format as
shown in Fig. 22, Fig. 23 or Fig. 24. The
announcement information having the format of Fig. 22
includes the order of priority assigned to the base
25 station transmitting the announcement information.
When the mobile station 205 receives the announcement
information having the format as shown in Fig. 22, the
mobile station 205 needs to acquire the announcement
information from the base stations other than the
30 source base station (the base station 201) that
transmitted the announcement information, in order to
learn the order of priority assigned to the base
stations adjacent to the source base station. The
format shown in Fig. 23 is such that the perch channel
35 codes corresponding to the source base station and the
adjacent base stations are arranged in the descending
order (or the ascending order) of the priority. The

1 format shown in Fig. 24 is such that each of the perch
channels code corresponding to the source base
stations and the adjacent base stations is coupled to
the associated order of priority. It will now be
5 assumed that the mobile station 205 has received the
announcement information having the format of Fig. 23.

The message channel control unit 308
reads the announcement information from the
announcement information storage unit 311 so as to
10 learn the order of priority assigned to the base
stations (the base stations 201, 202, 203 and 204) and
a predetermined level of the reception level that
enables a request for a message channel. It is
assumed that the base station 202, the base station
15 204, the base station 201 and the base station 203
have the increasingly higher priorities. The
reception level measuring unit 312 reads the
announcement information from the announcement
information storage unit 311 so as to retrieve the
20 order of priority included in the announcement
information to be assigned to the respective perch
channels codes, each of the perch channel codes
corresponding to the associated base station. The
reception level measuring unit 312 then measures the
25 reception level of the perch channel corresponding to
the base station 203 having the highest priority
(S406).

The reception level measuring unit 312
transmits the measured reception level to the message
30 channel control unit 308. The message channel control
unit 308 then determines whether the level is equal to
or exceeds a predetermined threshold level that
enables a request for a message channel. If the
message channel control unit 308 determines that the
35 level is equal to or exceeds the threshold level, the
mobile station 205 acquires the announcement
information from the base station 203 (S407). The

1 message channel control unit 308 obtains the order of
priority of the base stations 201, 202, 203 and 204
from the announcement information from the base
station 203. If the message channel control unit 308
5 determines that the level is below the threshold
level, the reception level measuring unit 312 measures
the reception level of the perch channel corresponding
to the base station 204 given the next highest
priority (S406). The reception level measuring unit
10 312 repeats step S406 such that it successively
measures the reception level in the perch channels in
the descending order of priority until the base
station providing a reception level which is equal to
or exceeds the threshold level is found or until all
15 the perch channels have been subject to measurement.

When there is an incoming call in the
mobile station 205 after S407 (S408, S409, S410, S411)
(S301 in Fig. 27), and when the order of priority of
the base stations 201, 202, 203 and 204 is included in
20 the announcement information (YES in S302), the
reception level measuring unit 312 reads the
announcement information from the announcement
information storage unit 311 so as to retrieve the
order of priority of the base stations 201, 202, 203
25 and 204, the order of priority being indicated by
information assigned to each of the perch channels
corresponding to the respective base stations 201,
202, 203 and 204. The reception level measuring unit
312 measures the reception level of the perch channel
30 corresponding to the base station 203 having the
highest priority. The order of priority stored in the
announcement information storage unit 312 is such that
the base station 201 < the base station 204 < the base
station 201 < the base station 203.

35 The reception level measuring unit 312
transmits the reception level of the perch channel
corresponding to the base station 203 to the message

1 channel control unit 308. The message channel control
unit 308 determines whether the reception level is
equal to or exceeds a predetermined threshold level
that enables a request for a message channel (S303).
5 If the message channel control unit 308 determines
that the reception level is equal to or exceeds the
threshold level (YES in S303), the message channel
control unit 308 retrieves restriction information
from the announcement information transmitted from the
10 base station 203 and stored in the announcement
information storage unit 311 so as to determine
whether call incoming is enabled in the zone 223
formed by the base station 203 (S308).

If the message channel control unit 308
15 determines in S303 that the reception level is below
the threshold level (NO in S303), the reception level
measuring unit 312 determines whether the base station
having the next highest priority is available (S304).
If no perch channel corresponding to the base station
20 having the next highest priority is available (NO in
S304), call incoming in the mobile station 205 is
disabled (S305) so that the mobile station 205 is put
in a wait state (S306). If the perch channel
corresponding to the base station having the next
25 highest priority is available (YES in S304), the
reception level measuring unit 312 repeats steps S304
and S307 such that it successively measures (NO in
S307) the reception level in the perch channels in the
descending order of priority until the base station
30 providing a reception level which is equal to or
exceeds the threshold level is found (YES in S307) or
until all the perch channels have been subject to
measurement (NO in S304). If the message channel
control unit 308 finds a base station that provides a
35 reception level which is equal to or exceeds the
threshold level (YES in S307), the message channel
control unit 308 retrieves the restriction information

1 from the announcement information stored in the
announcement information storage unit 311 so as to
determine if call incoming is enabled in the zone
5 formed by the base station found in S307 (S308). If
it is determined in S302 that the order of priority of
the base stations is not included in the announcement
information (NO in S302), the message channel control
unit 308 retrieves the restriction information from
10 the announcement information stored in the
announcement information storage unit 311 and
determines whether call incoming is enabled in the
zone formed by the base station which is the source of
the stored announcement information (S308).

If it is determined that call incoming
15 is disabled in the zone 223 formed by the base station
203 (NO in S303), the reception level measuring unit
312 determines whether the perch channel corresponding
to the base station having the next highest priority
is available (S304). If no perch channel
20 corresponding to the base station having the next
highest priority is available (NO in S304), call
incoming in the mobile station 205 is disabled (S305)
so that the mobile station 205 is put in a wait state
(S306). If the perch channel corresponding to the
25 base station having the next highest priority is
available (YES in S304), the reception level measuring
unit 312 repeats steps S304 and S307 such that it
successively measures (NO in S307) the reception level
in the perch channels in the descending order of
30 priority until the base station providing a reception
level which is equal to or exceeds the threshold level
is found (YES in S307) or until all the perch channels
have been subject to measurement (NO in S304). If the
message channel control unit 308 finds a base station
35 that provides a reception level which is equal to or
exceeds the threshold level (YES in S307), the message
channel control unit 308 retrieves the restriction

1 information from the announcement information stored
in the announcement information storage unit 311 so as
to determine if call incoming is enabled in the zone
formed by the base station found in S307 (S308).

5 If it is determined that call incoming
is enabled in the zone 223 formed by the base station
203 (YES in S308), the message channel control unit
308 retrieves the restriction information from the
announcement information transmitted from the base
10 station 203 and stored in the announcement information
storage unit 311 so as to determine whether a
restriction regarding a preferred mobile station is
imposed in the zone 223 formed by the base station 203
(S309).

15 If there is a restriction regarding a
preferred mobile station (YES in S309) and if the
mobile station 205 is a preferred mobile station (YES
in S310), the message channel control unit 308
determines whether call incoming is enabled in the
20 mobile station 205 (S311). If call incoming is
enabled (YES in S311), the message channel control
unit 308 determines that a request for a message
channel is to be issued to the base station 203 and
causes the transmission unit 310 to transmit a request
25 for a message channel (S412). If call incoming is
disabled (NO in S311), the mobile station 205 is put
in a wait state (S312).

If there is a restriction regarding a
preferred mobile station (YES in S309) and if the
30 mobile station 205 is not a preferred mobile station
(NO in S310), the message channel control unit 308
determines whether a restriction is imposed on the
mobile station 205 (S313). If there is no restriction
(NO in S313), the message channel control unit 308
35 determines that a request for a message channel is to
be issued to the base station 203 and causes the
transmission unit 310 to transmit a request for a

5 If it is determined that there is no
restriction regarding a preferred mobile station (NO
in S309), the message channel control unit 308
determines that a request for a message channel is to
be issued to the base station 203 and causes the
transmission unit 310 to transmit a request for a
10 message channel (S412).

The mobile station receiving the message channel assignment signal returns a response to an incoming call to the base station 203 (S309), establishes the assigned message channel with the base station 203 so as to start a call (S414).

35 It is assumed that, while the mobile
205 is communicating with another mobile station by
establishing a message channel with the base station

1 201 (S601 in Fig. 30), the reception level provided by
the base station 201 drops below a predetermined
threshold level, necessitating a handover by switching
message channels (S602) (S501 in Fig. 29). The
5 message channel control unit 308 determines whether
the order of priority is included in the announcement
information from the base station 201 (S602). The
announcement information obtained when the message
channel is set up with respect to the base station 201
10 and stored in the announcement information storage
unit 311 specifies the order such that the base
station 201 < the base station 202 < the base station
203 < the base station 204.

If it is determined that the order of
15 priority of the base stations 201, 202, 203 and 204 is
included in the announcement information (YES in
S502), the reception level measuring unit 312 reads
the announcement information from the announcement
information storage unit 311 so as to retrieve the
20 order of priority of the base stations 201, 202, 203
and 204 corresponding to the perch channel codes
included in the announcement information having the
format of, for example, Fig. 23. The reception level
measuring unit 312 measures the reception level in the
25 perch channel corresponding to the base station 204
assigned the next highest priority (S603).

The reception level measuring unit 312
transmits the reception level in the perch channel
corresponding to the base station 204 to the message
30 channel control unit 308. The message channel control
unit 308 determines whether the level is equal to or
exceeds a predetermined threshold level that enables a
request for a message channel (S503). If the message
channel control unit 308 determines that the level is
35 equal to or exceeds the threshold level (YES in S503),
the message channel control unit 308 retrieves
restriction information from the announcement

1 information transmitted from the base station 204 and
stored in the announcement information storage unit
311 so as to determine whether recall is enabled in
the zone 224 (S508).

5 If the message channel control unit 308
determines that the reception level is below the
threshold level (NO in S503), the reception level
measuring unit 312 determines whether the perch
channel corresponding to the base station having the
10 next highest priority next to the base station 204 is
available (S504). If no perch channel corresponding
to the base station having the next highest priority
is available (NO in S504), message channel switching
in the mobile station 205 is disabled (S505). In this
15 case, the mobile station 205 is disconnected or
switched back to the base station 201 (S506). If a
perch channel corresponding to the base station having
the next highest priority next to the base station 204
is available (YES in S504), the reception level
20 measuring unit 312 repeats steps S504 and S507 such
that it successively measures (NO in S307) the
reception level in the perch channels in the
descending order of priority until the base station
providing a reception level which is equal to or
25 exceeds the threshold level is found (YES in S507) or
until all the perch channels have been subject to
measurement (NO in S504). If the message channel
control unit 308 finds a base station that provides a
reception level which is equal to or exceeds the
30 threshold level (YES in S507), the message channel
control unit 308 retrieves the restriction information
from the announcement information stored in the
announcement information storage unit 311 so as to
determine if recall is enabled in the zone formed by
35 the base station found in S507 (S508). If it is
determined that the order of priority of the base
stations is not included in the announcement

1 information (NO in S502), the message channel control
unit 308 retrieves the restriction information from
the announcement information stored in the
announcement information storage unit 311 so as to
5 determine whether recall is enabled in the zone formed
by the base station which is the source of the stored
announcement information (S508).

If it is determined that recall is
disabled in the zone 224 formed by the base station
10 224 (NO in S504), message channel switching is
disabled in the mobile station 205 so that the mobile
station 205 is disconnected (S509). If recall is
disabled (YES in S508), the message channel control
unit 308 retrieves the restriction information from
15 the announcement information transmitted from the base
station 204 and stored in the announcement information
storage unit 311 so as to determine whether a
restriction regarding a preferred mobile station is
imposed in the zone 224 formed by the base station 204
20 (S510).

If there is a restriction regarding a
preferred mobile station (YES in S510) and if the
mobile station 205 is a preferred mobile station (YES
in S511), the message channel control unit 308
25 determines whether recall is enabled in the mobile
station 205 (S512). If it is determined that recall
is enabled (YES in S512), the message channel control
unit 308 determines that a request for a message
channel is to be issued to the base station 204 and
30 causes the transmission unit 310 to transmit a request
for a message channel (S604). If recall is disabled
(NO in S512), message channel switching in the mobile
station 205 is disabled so that the mobile station 205
is disconnected (S513).

35 If there is a restriction regarding a
preferred mobile station (YES in S510) and if the
mobile station 205 is not a preferred mobile station

1 (NO in S511), the message channel control unit 308
determines whether a restriction is imposed on the
mobile station 205 (S514). If there is no restriction
(NO in S514), the message channel control unit 308
5 determines that a request for a communication is to be
issued to the base station 204 and causes the
transmission unit 310 to transmit a request for a
message channel (S604). If there is a restriction
(YES in S514), message channel switching in the mobile
10 station 205 is disabled so that the mobile station 205
is disconnected (S515).

If it is determined that no restriction
regarding a preferred mobile station is imposed (NO in
S510), the message channel control unit 308 determines
15 that a request for a message channel is to be issued
to the base station 204 and causes the transmission
unit 310 to transmit a request for a message channel
(S604) (S516).

The base station 204 receiving the
20 request assigns an unused message channel to the
mobile station 205 and transmits a channel assignment
signal thereto (S605). If no unused message channel
is available, the mobile station 205 is disconnected.

The mobile station receiving the
25 message channel assignment signal establishes the
assigned message channel with the base station 204 so
as to continue a call (S606).

As described above, the present
invention as applied to a mobile communication system
30 having a hierarchical zone construction enables a
mobile station to issue a request for a message
channel to a base station that forms a smaller zone
and provides a lower reception level, instead of a
base station that forms a larger zone and provides a
35 higher reception level. The present invention
accomplishes such an arrangement by including in the
announcement information the order of priority

1 assigned to each of the base stations constituting the
hierarchical zone construction.

The present invention is not limited to the
above described embodiments, and variations and
5 modifications may be made without departing from the
scope of the present invention.

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1 WHAT IS CLAIMED IS:

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1. A mobile communication system
comprising:

 a plurality of radio base stations
forming respective radio zones and effecting a radio
10 channel setting control in accordance with a
predetermined procedure; and

 a mobile station selecting, as a wait
zone, one of the radio zones that satisfies a criteria
demanded by the predetermined procedure, and receiving
15 communication service via the selected wait zone,

 each of the radio base stations
comprising:

 traffic control means for setting a
traffic distribution for the plurality of radio zones;
20 and

 announcing means for generating
announcement information including the order of
priority assigned to the plurality of radio zones, the
order of priority being assigned in accordance with a
25 probability density given to each of the plurality of
radio zones under the distribution set by the traffic
control means, and for transmitting announcement
information to the radio zone formed by the radio
station to which the announcing means belongs,

30 the mobile station comprising:

 announcement information receiving
means for receiving the announcement information
transmitted by the announcing means in accordance with
the predetermined procedure; and

35 wait control means for selecting one of
the radio zones as a wait zone, the radio zone to
which a highest priority is assigned being a first

1 candidate for selection by the wait control means.

5

2. A mobile communication system
comprising:

a plurality of radio base stations
forming one or a plurality of radio zones and one or a
10 plurality of small-scale radio zones, resulting in a
hierarchy of overlapping radio zones, and effecting a
radio channel setting control in accordance with a
predetermined procedure; and

a mobile station accessing one of the
15 radio zones formed by the respective one of the
plurality of radio base stations, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone,

each of the plurality of radio base
20 stations comprising:

announcing means for transmitting
announcement information which includes identification
information for identifying radio channels assigned to
respective radio zones and small-scale radio zones,
25 via the radio channel assigned to the radio zone
formed by the radio base station to which the
announcing means belongs, the identification
information being arranged in the announcement
information so as to correspond to the hierarchy of
30 overlapping radio zones,

the mobile station comprising:
announcement information receiving
means for receiving the announcement information
transmitted by the announcing means, in accordance
35 with the procedure for radio channel setting control;

measuring means for measuring an
electric field intensity for the radio channel

1 corresponding to the identification information
included in the announcement information received by
the announcement information receiving means; and
wait control means for comparing an
5 electric field intensity measured by the measuring
means with a preset threshold level, and designating a
radio zone to which the radio channel lowest in the
hierarchy is assigned as a wait zone in which to
receive the communication service, on the condition
10 that the electric field intensity measured by the
measuring means exceeds the preset threshold level.

15

3. A mobile communication system
comprising:

a plurality of radio base stations
forming one or a plurality of radio zones and one or a
20 plurality of small-scale radio zones, resulting in a
hierarchy of overlapping zones, and effecting a radio
channel setting control in accordance with a
predetermined procedure; and

a mobile station accessing one of the
25 radio zones formed by the respective one of the
plurality of radio base stations, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone,

each of the plurality of radio base
30 stations comprising:

announcing means for transmitting
announcement information which includes identification
information for identifying the one or the plurality
of radio zones and the one or the plurality of small-
35 scale radio zones, via the radio channel assigned to
the radio zone formed by the radio base station to
which the announcing means belongs, the identification

1 information being arranged in the announcement
information according to respective positions in the
hierarchy of overlapping zones,
the mobile station comprising:
5 announcement information receiving
means for receiving the announcement information
transmitted by the announcing means, in accordance
with the procedure for radio channel setting control;
measuring means for measuring an
10 electric field intensity for the radio zone
corresponding to the identification information
included in the announcement information received by
the announcement information receiving means; and
wait control means for comparing an
15 electric field intensity measured by the measuring
means with a preset threshold level, and designating,
as a wait zone in which to receive the communication
service, a radio zone lowest in the hierarchy of
overlapping zones on the condition that the electric
20 field intensity measured by the measuring means
exceeds the threshold level.

25

4. A mobile communication system
comprising:

a plurality of radio base stations
forming one or a plurality of radio zones and one or a
30 plurality of small-scale radio zones, resulting in a
hierarchy of overlapping zones, and effecting a radio
channel setting control in accordance with a
predetermined procedure; and
a mobile station accessing one of the
35 radio zones formed by the respective one of the
plurality of radio base stations, in accordance with a
predetermined procedure, and receiving communication

1 service via the accessed radio zone,
each of the plurality of radio base
stations comprising:
announcing means for transmitting
5 announcement information which includes identification
information for identifying radio channels for the one
or the plurality of radio zones and the one or the
plurality of small-scale radio zones, via the radio
channel assigned to the radio zone formed by the radio
10 base station to which the announcing means belongs,
the identification information being arranged in the
announcement information according to respective
positions in the hierarchy of overlapping zones,
the mobile station comprising:
15 announcement information receiving
means for receiving the announcement information
transmitted by the announcing means, in accordance
with the procedure for radio channel setting control;
measuring means for measuring an
20 electric field intensity for the radio channel
corresponding to the identification information
included in the announcement information received by
the announcement information receiving means; and
wait control means for comparing an
25 electric field intensity measured by the measuring
means with a preset threshold level, and designating
one of the radio channels, which is assigned to the
radio zone lowest in the hierarchy and for which the
control means has determined that the electric field
30 intensity measured by the measuring means exceeds the
preset threshold level, as a radio channel via which
to receive the communication service.

35

5. A mobile communication system

1 comprising:

a plurality of radio base stations forming one or a plurality of radio zones and one or a plurality of small-scale radio zones, resulting in a hierarchy of overlapping zones, and effecting a radio channel setting control in accordance with a predetermined procedure; and

a mobile station accessing one of the radio zones formed by the respective one of the plurality of radio base stations, in accordance with a predetermined procedure, and receiving communication service via the accessed radio zone,

each of the plurality of radio base stations comprising:

announcing means for transmitting announcement information which includes identification information for identifying the one or the plurality of radio zones and the one or the plurality of small-scale radio zones, via the radio channel assigned to the radio zone formed by the radio base station to which the announcing means belongs, the identification information being arranged in the announcement information according to respective positions in the hierarchy of overlapping zones,

the mobile station comprising:

announcement information receiving means for receiving the announcement information transmitted by the announcing means, in accordance with the procedure for radio channel setting control;

measuring means for measuring an electric field intensity for the radio zone corresponding to the identification information included in the announcement information received by the announcement information receiving means; and

wait control means for comparing an electric field intensity measured by the measuring means with a preset threshold level, and designating,

1 as a wait zone in which to receive the communication
service, a radio zone identified by the identification
information to be lowest in the hierarchy of
overlapping zones, on the condition that the electric
5 field intensity measured by the measuring means
exceeds the threshold level.

10

6. A mobile communication system
comprising:

a plurality of radio base stations
forming one or a plurality of radio zones and one or a
15 plurality of small-scale radio zones, resulting in a
hierarchy of overlapping zones, and effecting a radio
channel setting control in accordance with a
predetermined procedure; and

a mobile station accessing one of the
20 radio zones formed by the respective one of the
plurality of radio base stations, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone,

each of the plurality of radio base
25 stations comprising:

announcing means for transmitting
announcement information which includes first
identification information for identifying a radio
channel assigned to the radio zone formed by the radio
30 base station to which the announcing means belongs, as
well as including second identification information
identifying the radio zones and the small-scale radio
zones which overlap the radio zone formed by the radio
base station to which the announcing means belongs,
35 via the radio channel assigned to the radio zone
formed by the radio base station to which the
announcing means belongs, the second identification

1 information being arranged in the announcement
information according to respective positions in the
hierarchy of overlapping zones,
the mobile station comprising:
5 announcement information receiving
means for receiving the announcement information
transmitted by the announcing means, in accordance
with the procedure for radio channel setting control;
measuring means for measuring an
10 electric field intensity for the radio channel
corresponding to the identification information
included in the announcement information received by
the announcement information receiving means; and
wait control means for comparing an
15 electric field intensity measured by the measuring
means with a preset threshold level, determining the
radio channel which is identified by the associated
second identification information, if available, to
have a lowest hierarchical order, and designating, as
20 a wait zone in which to receive the communication
service, the radio zone to which the determined radio
channel is assigned, on the condition that the
electric field intensity measured by the measuring
means exceeds the threshold level.
25

7. A mobile communication system
30 comprising:
a plurality of radio base stations
forming one or a plurality of radio zones and one or a
plurality of small-scale radio zones, resulting in a
hierarchy of overlapping zones, and effecting a radio
35 channel setting control in accordance with a
predetermined procedure; and
a mobile station accessing one of the

1 radio zones formed by the respective one of the
plurality of radio base stations, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone,

5 each of the plurality of radio base
stations comprising:

announcing means for transmitting
announcement information which includes first
identification information for identifying a radio
10 channel assigned to a radio zone formed by the radio
base station to which the announcing means belongs, as
well as including second identification information
identifying the radio zones and the small-scale radio
zones which overlap the radio zone formed by the radio
15 base station to which the announcing means belongs,
over the radio zone formed by the radio base station
to which the announcing means belongs, the second
identification information being arranged in the
announcement information according to respective
20 positions in the hierarchy of overlapping zones,

the mobile station comprising:

announcement information receiving
means for receiving the announcement information
transmitted by the announcing means, in accordance
25 with the procedure for radio channel setting control;

measuring means for measuring an
electric field intensity for the radio zone
corresponding to the identification information
included in the announcement information received by
30 the announcement information receiving means; and

wait control means for comparing an
electric field intensity measured by the measuring
means with a preset threshold level, determining the
radio zone corresponding to the radio channel which is
35 identified by the associated second identification
information, if available, to have a lowest
hierarchical order, and designating the determined

1 radio zone as a wait zone in which to receive the
communication service on the condition that the
electric field intensity measured by the measuring
means exceeds the threshold level.

5

8. A mobile communication system
10 comprising:

a plurality of radio base stations
forming one or a plurality of radio zones and one or a
plurality of small-scale radio zones, resulting in a
hierarchy of overlapping zones, and effecting a radio
15 channel setting control in accordance with a
predetermined procedure; and

a mobile station accessing one of the
radio zones formed by the respective one of the
plurality of radio base stations, in accordance with a
20 predetermined procedure, and receiving communication
service via the accessed radio zone,

each of the plurality of radio base
stations comprising:

announcing means for transmitting
25 announcement information which includes a hierarchical
(equal or subordinate) order of the radio zone formed
by the radio base station to which the announcing
means belongs with respect to the overlapping radio
zones and small-scale radio zones, and which also
30 includes identification information for identifying
radio channels assigned to the radio zone formed by
the radio base station to which the announcing means
belongs and the overlapping radio zones and small-
scale radio zones, via the radio channel assigned to
35 the radio zone formed by the radio base station to
which the announcing means belongs,

the mobile station comprising:

1 announcement information receiving
means for receiving the announcement information
transmitted by the announcing means, in accordance
with the procedure for radio channel setting control,
5 for extracting the identification information from the
announcement information, and for determining the
hierarchy of the radio zones to which the radio
channels identified by the identification information
are assigned;

10 measuring means for measuring an
electric field intensity for the radio channel
corresponding to the identification information
obtained by the announcement information receiving
means; and

15 wait control means for comparing an
electric field intensity measured by the measuring
means with a preset threshold level, and designating a
radio zone to which the radio channel lowest in the
hierarchy is assigned as a wait zone in which to
20 receive the communication service, on the condition
that the electric field intensity measured by the
measuring means for the radio channel lowest in the
hierarchy exceeds the preset threshold level.

25

9. A mobile communication system
comprising:

30 a plurality of radio base stations
forming one or a plurality of radio zones and one or a
plurality of small-scale radio zones, resulting in a
hierarchy of overlapping zones, and effecting a radio
channel setting control in accordance with a
35 predetermined procedure; and

a mobile station accessing one of the
radio zones formed by the respective one of the

1 plurality of radio base stations, in accordance with a
predetermined procedure, and receiving communication
service via the accessed radio zone, each of the
plurality of radio base stations comprising:

5 announcing means for transmitting
announcement information which includes a hierarchical
(equal or subordinate) order of the radio zone formed
by the radio base station to which the announcing
means belongs with respect to the overlapping radio
10 zones and small-scale radio zones, and which also
includes identification information for identifying
the radio zone formed by the radio base station to
which the announcing means belongs and the overlapping
radio zones and small-scale radio zones, over the
15 radio zone formed by the radio base station to which
the announcing means belongs,

the mobile station comprising:

announcement information receiving
means for receiving the announcement information
20 transmitted by the announcing means, in accordance
with the procedure for radio channel setting control,
for extracting the identification information from the
announcement information, and for determining the
hierarchy of the radio zones corresponding to the
25 identification information;

measuring means for measuring an
electric field intensity for the radio zone
corresponding to the identification information
extracted by the announcement information receiving
30 means 14g; and

wait control means for comparing an
electric field intensity measured by the measuring
means with a preset threshold level, and designating a
radio zone lowest in the hierarchy determined by the
35 announcement information receiving means as a wait
zone in which to receive the communication service, on
the condition that the electric field intensity

1 measured by the measuring means for the radio zone
lowest in the hierarchy exceeds the preset threshold
level.

5

10 10. The mobile communication system as
claimed in claim 2, wherein said announcing means
comprises means for adding, in the announcement
information, preset threshold values individually
provided for the radio zone formed by the radio base
station to which the announcing means belongs and the
overlapping radio zones and small-scale radio zones,
15 resulting in a hierarchy that corresponds to the
hierarchy of overlapping zones, and
said wait control means employs the
threshold values added to the announcement information
by the announcing means in making comparisons with the
20 electric field intensity.

25 11. The mobile communication system as
claimed in claim 2 wherein announcing means comprises
means for adding a relative value indicating the
preset threshold value for the zone formed by the
radio base station to which the announcing means
30 belongs, in the form of a difference with respect to a
reference value for the threshold value, and
said announcement information receiving
means includes means for determining the relative
value added to the announcement information, in
35 relation to the radio zone in which the announcement
information is received, and
said wait control means compares the

1 electric field intensity measured by the measuring
means with a sum of the reference value and the
relative value determined by the announcement
information receiving means in relation to the radio
5 zone in which the electric field intensity is
measured.

10

12. The mobile communication system as
claimed in claim 2, wherein said announcing means
comprises means for adding relative values indicating
the preset threshold values for the radio zone formed
15 by the radio base station to which the announcing
means belongs and the overlapping radio zones and
small-scale radio zones, in the form of differences
with respect to a reference value common to the
threshold values, resulting in a hierarchy that
20 corresponds to the hierarchy of overlapping zones, and
said wait control means compares the
electric field intensity with a sum of the relative
value and the reference value.

25

13. The mobile communication system as
claimed in claim 2, wherein said mobile station
30 comprises zone determination means for performing a
cyclic measurement of the electric field intensity of
the radio zones in which the mobile station can be
located, comparing a measured electric field intensity
with a lower acceptance value by which an entry into
35 the radio zone is enabled, stopping processes of
measurement and comparison when it is found that the
former exceeds the latter, and selecting the

1 associated radio zone as a candidate in which the
announcement information receiving means is to receive
the announcement information.

5

14. The mobile communication system as
claimed in claim 2, wherein said wait control means
10 compares the electric field intensity measured by the
measuring means with the threshold value in the
descending order in the hierarchy of the radio zones
subject to the measurement, and designates the radio
zone for which it is found that the former exceeds the
15 latter as a wait zone.

20 15. The mobile communication system as
claimed in claim 13, wherein said measuring means
comprises means which omits a measurement of the radio
zone selected by the zone determination means and
substitutes therefor the electric field intensity
25 measured by the zone determination means.

30 16. A mobile station comprising:
announcement information receiving
means for receiving announcement information including
orders of priority assigned to radio zones formed by a
plurality of radio base stations, the reception by the
35 announcement information receiving means being
conducted according to a descending order of preset
traffic distribution and in accordance with a radio

1 channel setting control procedure;

wait means for determining whether the
radio zone associated with the order of priority
included in the announcement information received by
5 the announcement information receiving means satisfies
a criteria adapted for the radio channel setting
control procedure, and for designating the radio zone
for which an affirmative answer is given as a wait
zone; and

10 communication control means which
receives communication service from the radio base
station forming the radio zone designated by the wait
means.

15

17. A mobile communication system
comprising:

20 a plurality of base stations forming
respective radio zones that overlap each other;
a mobile station transportable between
said radio zones; wherein

each of said plurality of base stations
25 comprises:

announcing means for sending
announcement information including an order of
priority of said plurality of base stations to the
mobile station located in one of said radio zones, and

30 said mobile station comprises:

control means for selecting the base
station to which a request for a message channel is to
be issued, based on the order of priority of the base
stations included in the announcement information
35 transmitted from said plurality of base stations.

1 18. The mobile communication system as
claimed in claim 17, wherein said mobile station
further comprises:

 announcement information receiving
5 means for receiving the announcement information
including the order of priority of said plurality of
base stations and transmitted from said plurality of
base stations; and

 transmission means for issuing a
10 request for a message channel to the base station
selected by said control means.

15 19. The mobile communication system as
claimed in claim 17, wherein said mobile station
further comprises:

 storage means for storing the
20 announcement information;

 measuring means for measuring a
reception level in reception-level determining
channels in a descending order of priority of said
plurality of base stations, based on the announcement
25 information stored in said storage means and including
the order of priority and based on information
relating to the reception-level determining channels.

30

 20. The mobile communication system as
claimed in claim 19, wherein said control means
includes determining means for determining whether the
35 reception level in a reception-level determining
channel is equal to or exceeds a predetermined level
that enables a request for a message channel.

1 21. The mobile communication system as
claimed in claim 17, wherein said announcing means
includes first arranging means for ordering the
announcement information so as to arrange information
5 relating to reception-level determining channels in a
descending order of priority.

10 22. The mobile communication system as
claimed in claim 17, wherein said announcing means
includes second arranging means for ordering the
announcement information so as to couple information
15 relating to each reception-level determining channel
to an order of priority associated therewith.

20 23. The mobile communication system as
claimed in claim 18, wherein said transmission means
includes first transmission means for issuing a
request for a message channel to the base station
25 selected by the control means when a call is
originated.

30 24. The mobile communication system as
claimed in claim 18, wherein said transmission means
includes second transmission means for issuing a
request for a message channel to the base station
35 selected by the control means when a call is incoming.

1 25. The mobile communication system as
claimed in claim 18, wherein said transmission means
includes third transmission means for transmitting a
request for a communication to the base station
5 selected by the control means when a message channel
is switched from one to another in the event of a
handover of a call.

10

 26. A mobile station for use in a
mobile communication system, comprising control means
for selecting a base station to which a request for a
15 message channel is to be issued, based on an order of
priority of a plurality of base stations included in
announcement information from said plurality of base
stations.

20

 27. The mobile station as claimed in
claim 26, further comprising:
25 announcement information receiving
means for receiving, from said plurality of base
stations, the announcement information including the
order of priority of said plurality of base stations;
and
30 transmission means for transmitting a
request for a message channel to the base station
selected by said control means.

35

 28. The mobile station as claimed in

1 claim 26, further comprising:
storage means for storing the
announcement information;
measuring means for measuring a
5 reception level in reception-level determining
channels in a descending order of priority of said
plurality of base stations, based on the announcement
information stored in said storage means and including
the order of priority and based on information
10 relating to the reception-level determining channels.

15 29. The mobile station as claimed in
claim 28, wherein said control means includes
determining means for determining whether the
reception level in a reception-level determining
channel is equal to or exceeds a predetermined level
20 that enables a request for a message channel.

25 30. The mobile station as claimed in
claim 27, wherein said transmission means includes
first transmission means for issuing a request for a
message channel to the base station selected by the
control means when a call is originated.

30

35 31. The mobile station as claimed in
claim 27, wherein said transmission means includes
second transmission means for issuing a request for a
message channel to the base station selected by the

1 control means when a call is incoming.

5

32. The mobile station as claimed in
claim 27, wherein said transmission means includes
third transmission means for transmitting a request
for a communication to the base station selected by
10 the control means when a message channel is switched
from one to another in the event of a handover of a
call.

15

33. A base station forming a radio zone
that overlaps radio zones formed by other base
stations in a mobile communication system;
20 announcing means for sending
announcement information including an order of
priority of a plurality of base stations constituting
the mobile communication system to a mobile station
located in one of the radio zones.

25

34. The base station as claimed in
30 claim 33, wherein said announcing means includes first
arranging means for ordering the announcement
information so as to arrange information relating to
reception-level determining channels in a descending
order of priority.

35

1 35. The base station as claimed in
claim 33, wherein said announcing means includes
second arranging means for ordering the announcement
information so as to couple information relating to
5 each reception-level determining channel to an order
of priority associated therewith.

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1 ABSTRACT OF THE DISCLOSURE

 A mobile communication system includes
a plurality of radio base stations forming respective
radio zones and a mobile station selecting a wait zone
5 and a base station to which a request for a message
channel is to be issued. Each of the plurality of
radio base stations is assigned an order of priority.
Information relating to the order of priority is used
by the mobile station to select a wait zone and a base
10 station to which a request for a message channel is to
be issued.

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FIG. 1
PRIOR ART

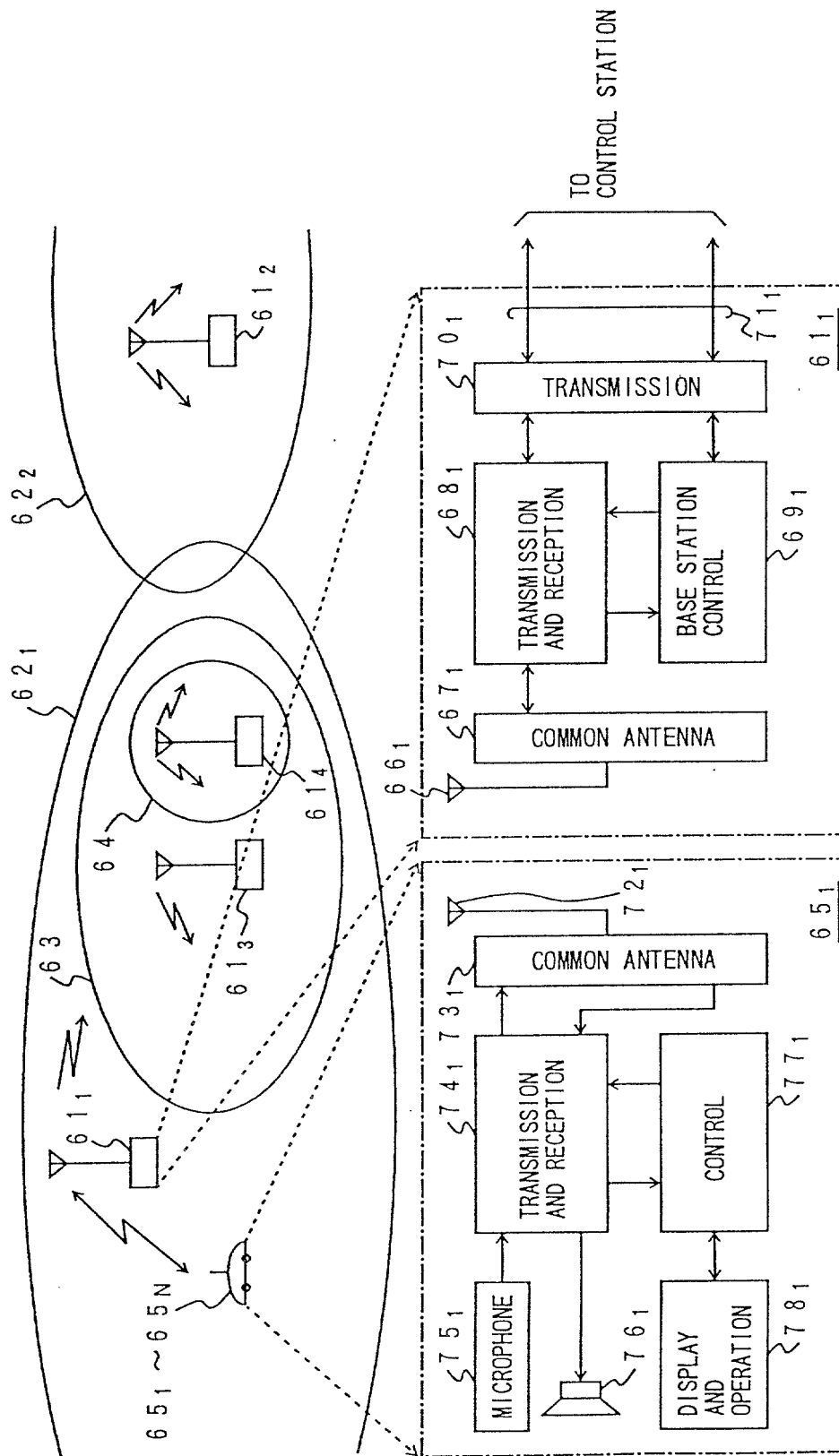


FIG. 2 PRIOR ART

RESTRICTION

MESSAGE TYPE
NETWORK CODE
CONTROL INFORMATION
CONTROL CHANNEL CONFIGURATION INFORMATION
MOBILE STATION TRANSMISSION POWER SPECIFICATION
WAIT ENABLED LEVEL
WAIT DISABLED LEVEL
LOCATION REGISTERED AREA MULTIPLEX LEVEL
LOCATION CODE 1
⋮
LOCATION CODE N
MAXIMUM REPORTED NUMBER OF CHANNELS
⋮

FIG. 3
PRIOR ART

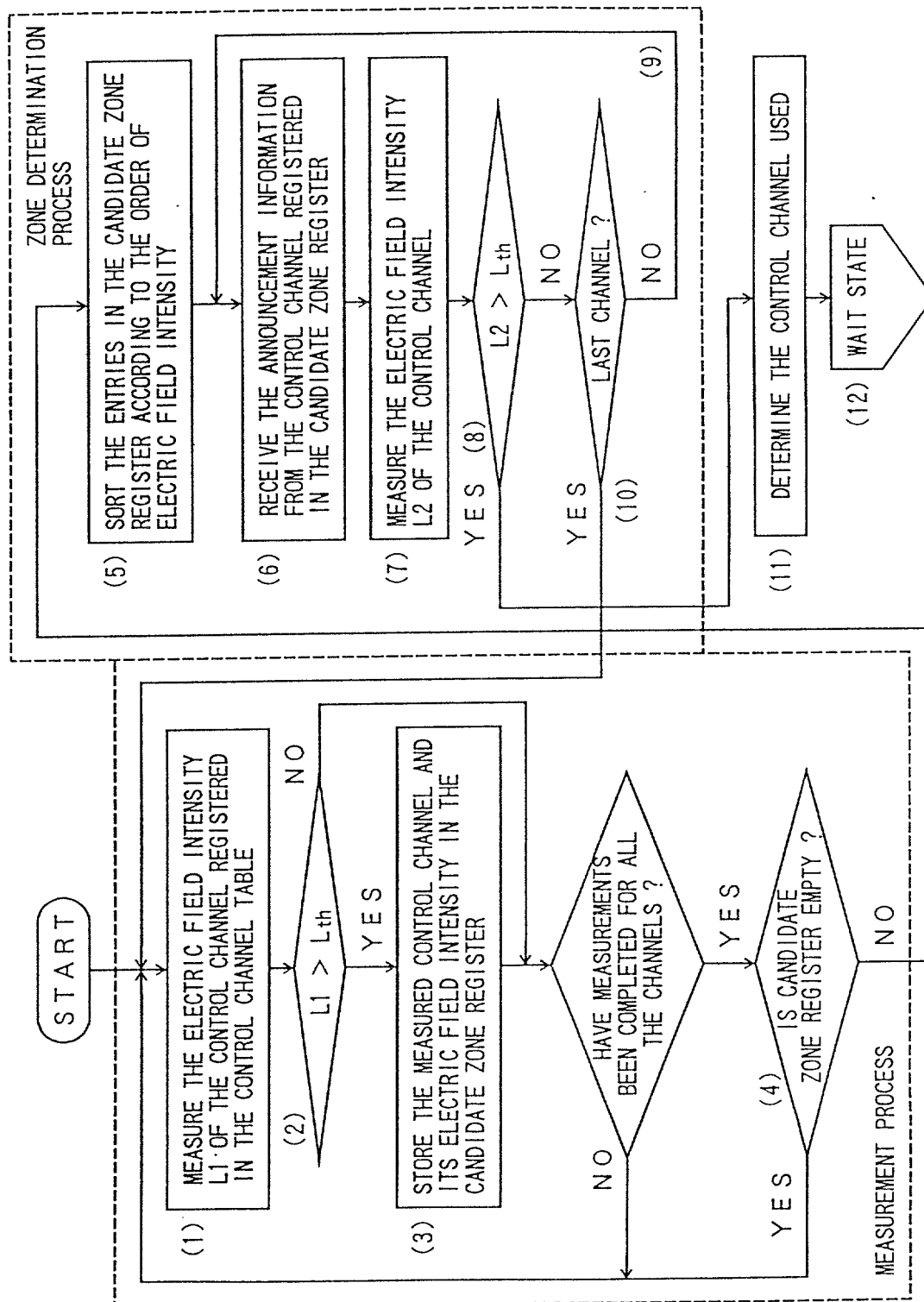
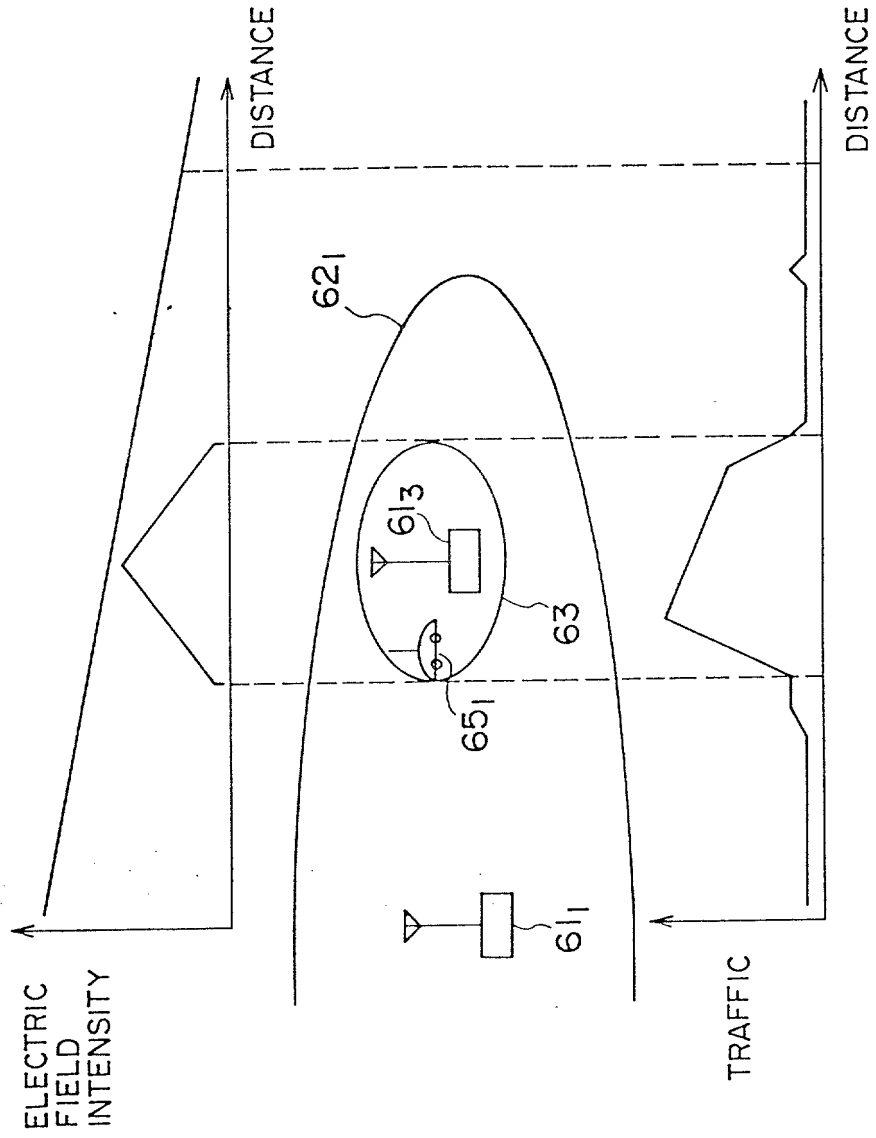


FIG. 4
PRIOR ART



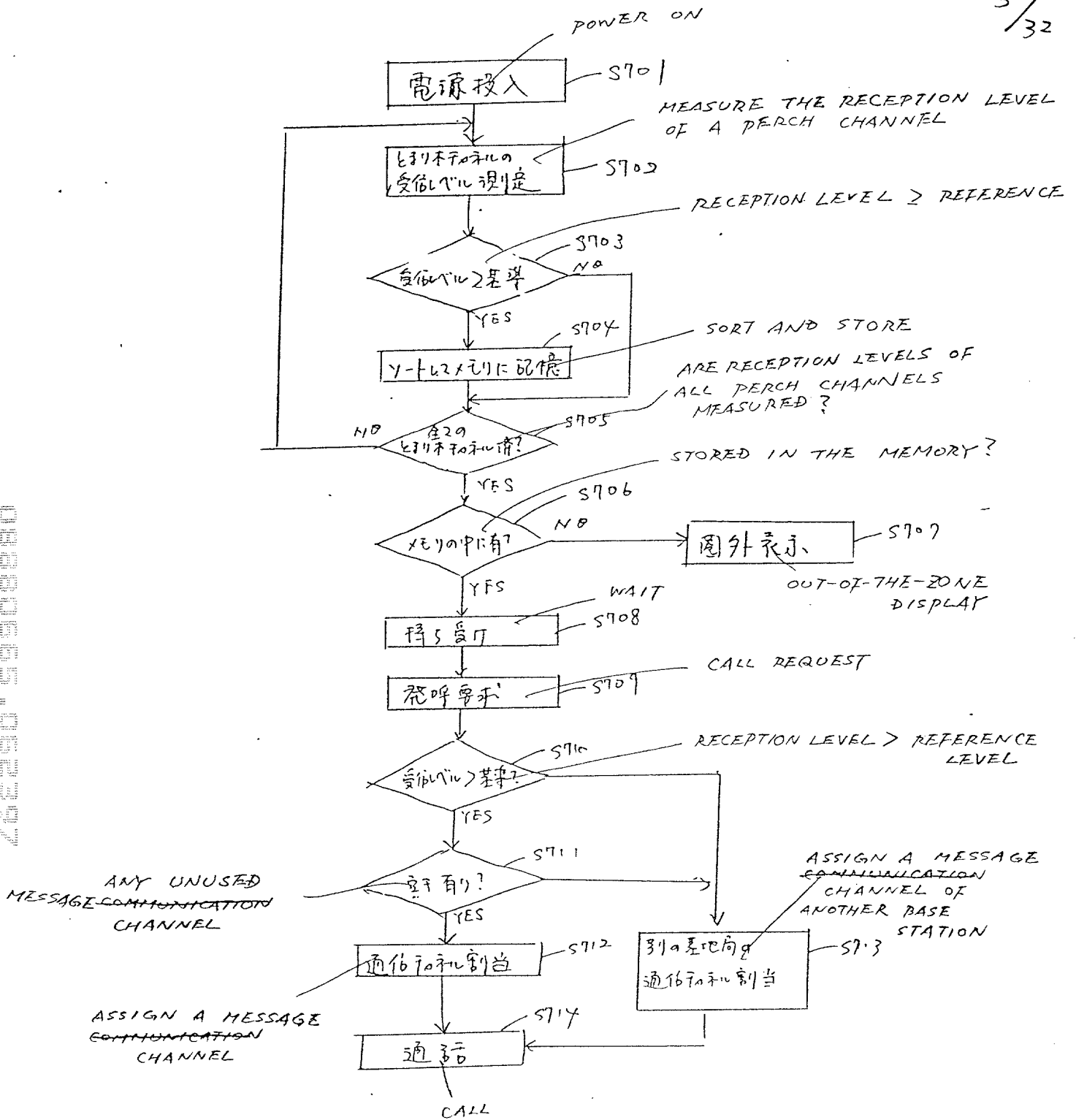


Fig. 5

PRIOR ART

FIG. 6

FIG. 5

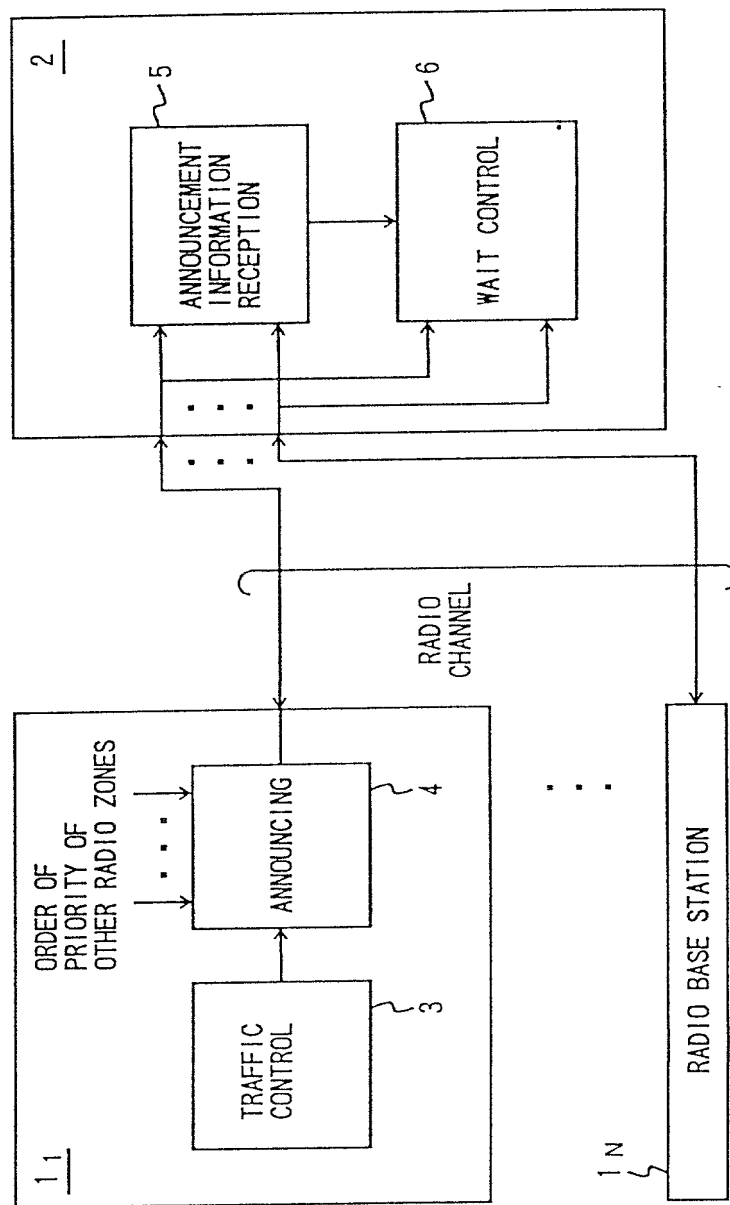


FIG. 17

FIG. 6

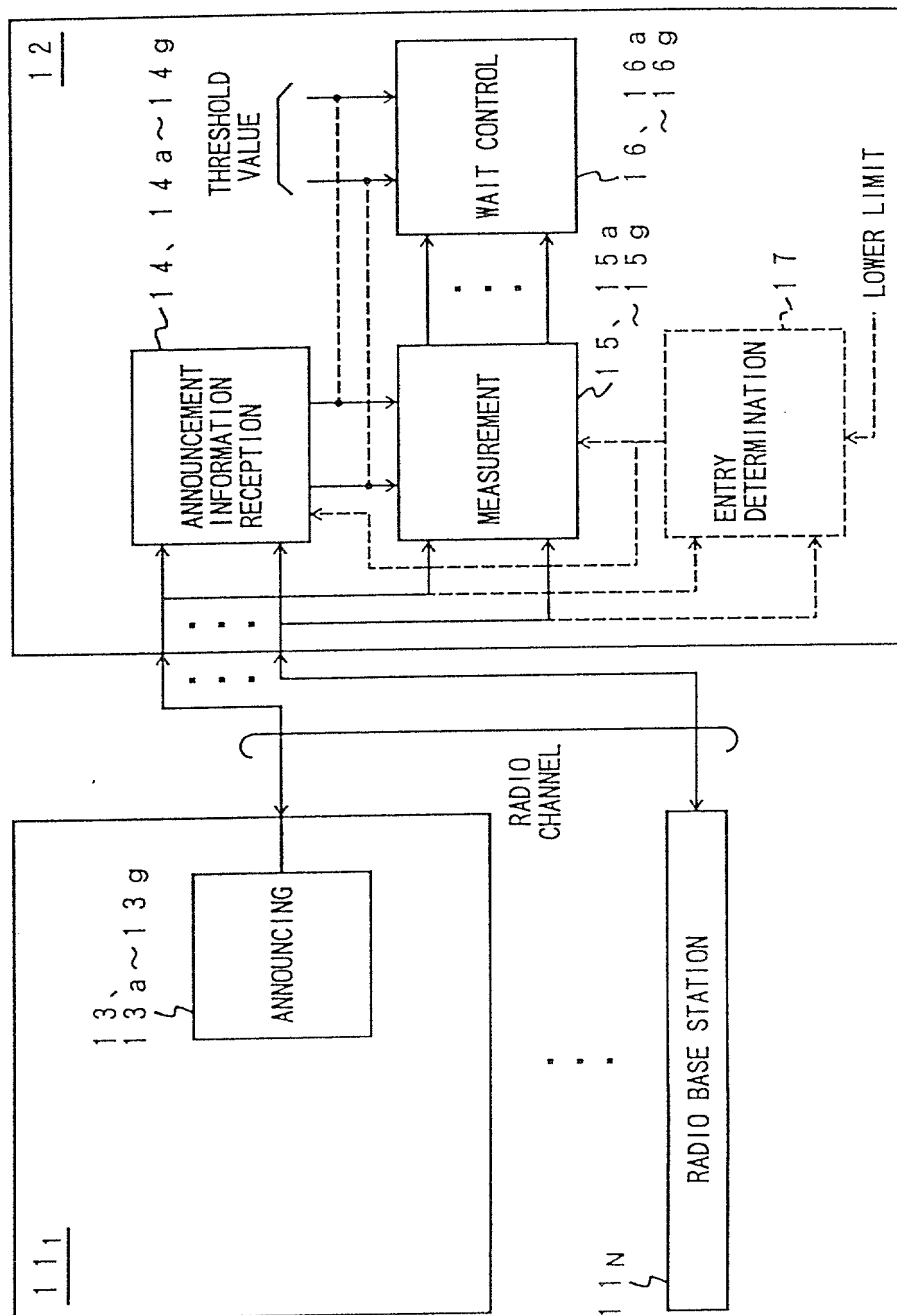


FIG. 8

FIG. 7

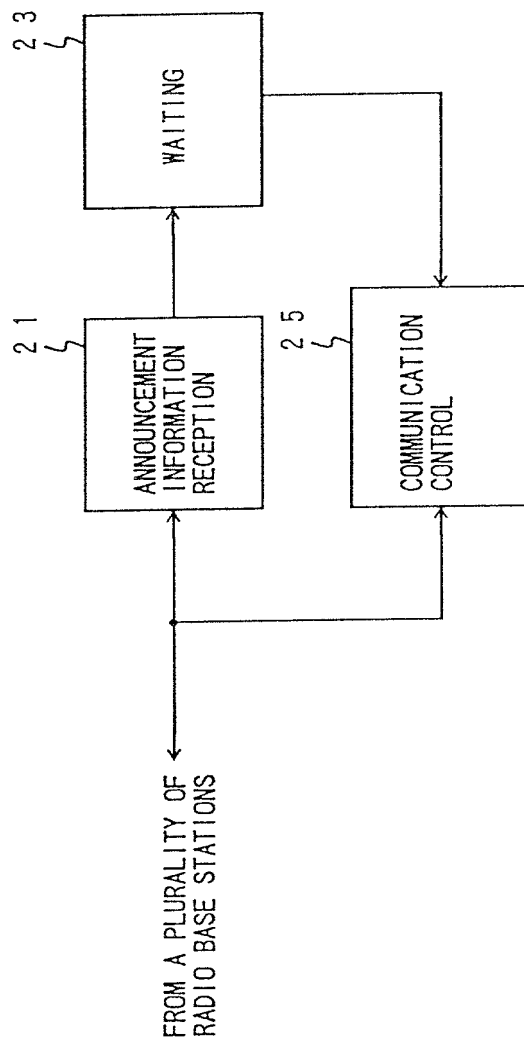


FIG. 9

FIG. 8

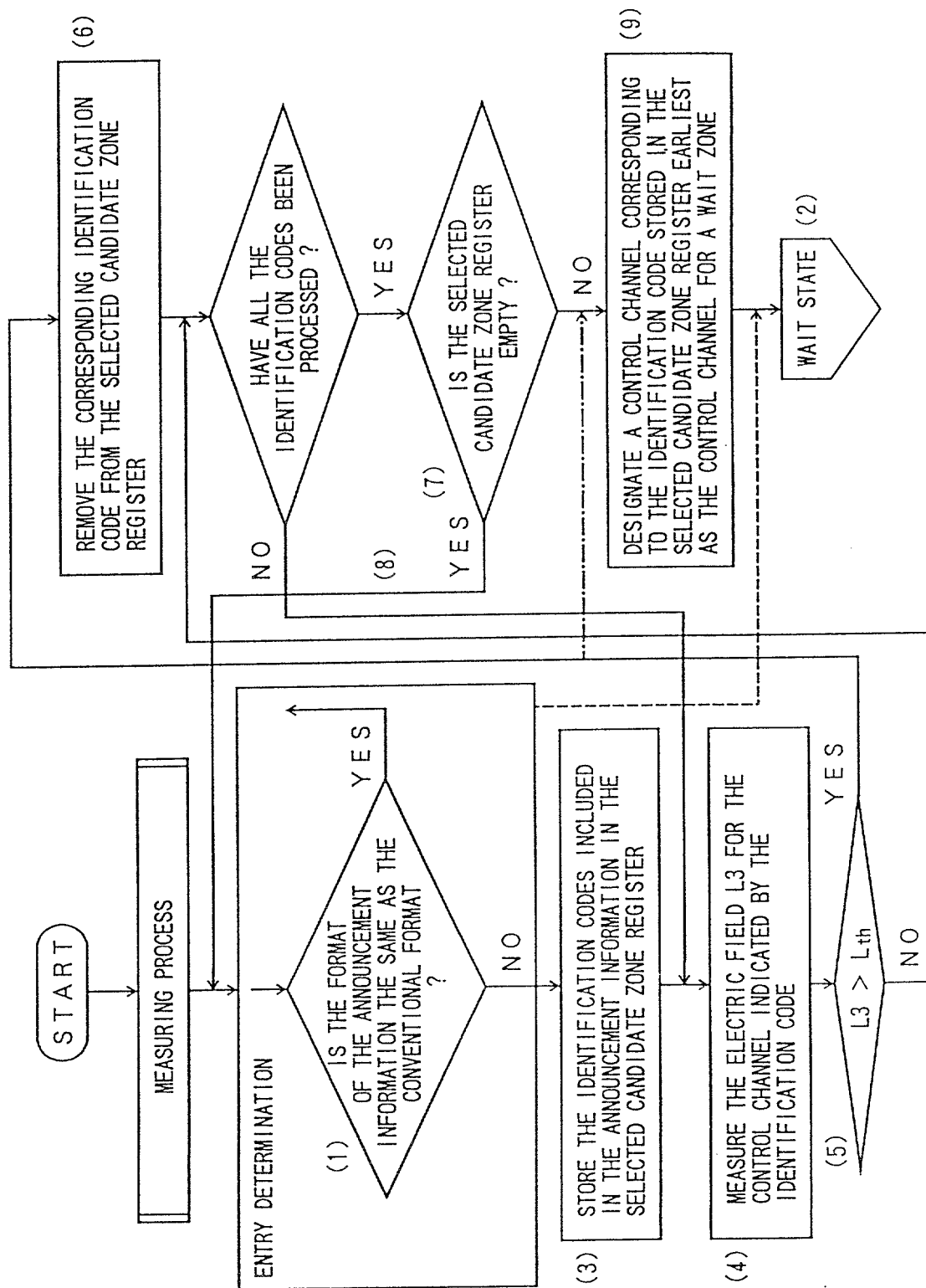


FIG. 10

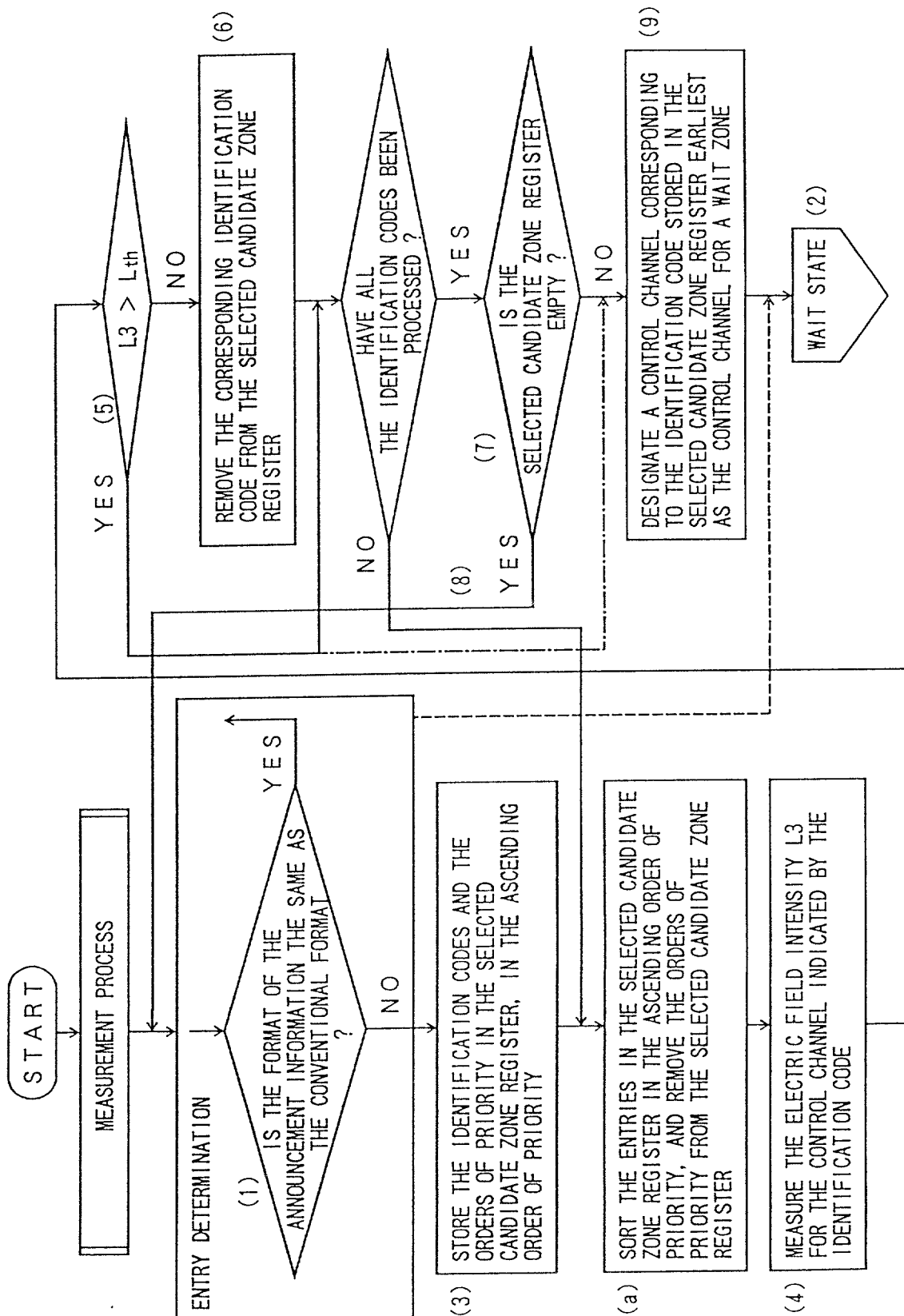
~~FIG. 9~~

MESSAGE TYPE
⋮
MOBILE STATION TRANSMISSION POWER SPECIFICATION
CONTROL CHANNEL IDENTIFICATION CODE C ₄
CONTROL CHANNEL IDENTIFICATION CODE C ₃
CONTROL CHANNEL IDENTIFICATION CODE C ₁
WAIT ENABLED LEVEL (LOCAL)
WAIT DISABLED LEVEL (LOCAL)
LOCATION REGISTERED AREA MULTIPLEX LEVEL
⋮

4.6220" 5992220

FIG. 11

FIG. 10



~~FIG. 11~~

MESSAGE TYPE
<div style="text-align: center;"> . . . </div>
MOBILE STATION TRANSMISSION POWER SPECIFICATION
CONTROL CHANNEL IDENTIFICATION CODE C_1
ORDER OF PRIORITY P_1
CONTROL CHANNEL IDENTIFICATION CODE C_3
ORDER OF PRIORITY P_3
CONTROL CHANNEL IDENTIFICATION CODE C_4
ORDER OF PRIORITY P_4
WAIT ENABLED LEVEL (LOCAL)
WAIT DISABLED LEVEL (LOCAL)
LOCATION REGISTERED AREA MULTIPLEX LEVEL
<div style="text-align: center;"> . . . </div>

MESSAGE TYPE
<p style="text-align: center;">.</p> <p style="text-align: center;">.</p> <p style="text-align: center;">.</p>
MOBILE STATION TRANSMISSION POWER SPECIFICATION
ORDER OF PRIORITY P_1
CONTROL CHANNEL IDENTIFICATION CODE C_1
CONTROL CHANNEL IDENTIFICATION CODE C_4
CONTROL CHANNEL IDENTIFICATION CODE C_3
WAIT ENABLED LEVEL (LOCAL)
WAIT DISABLED LEVEL (LOCAL)
LOCATION REGISTERED AREA MULTIPLEX LEVEL
<p style="text-align: center;">.</p> <p style="text-align: center;">.</p> <p style="text-align: center;">.</p>

FIG. 14

FIG. 13

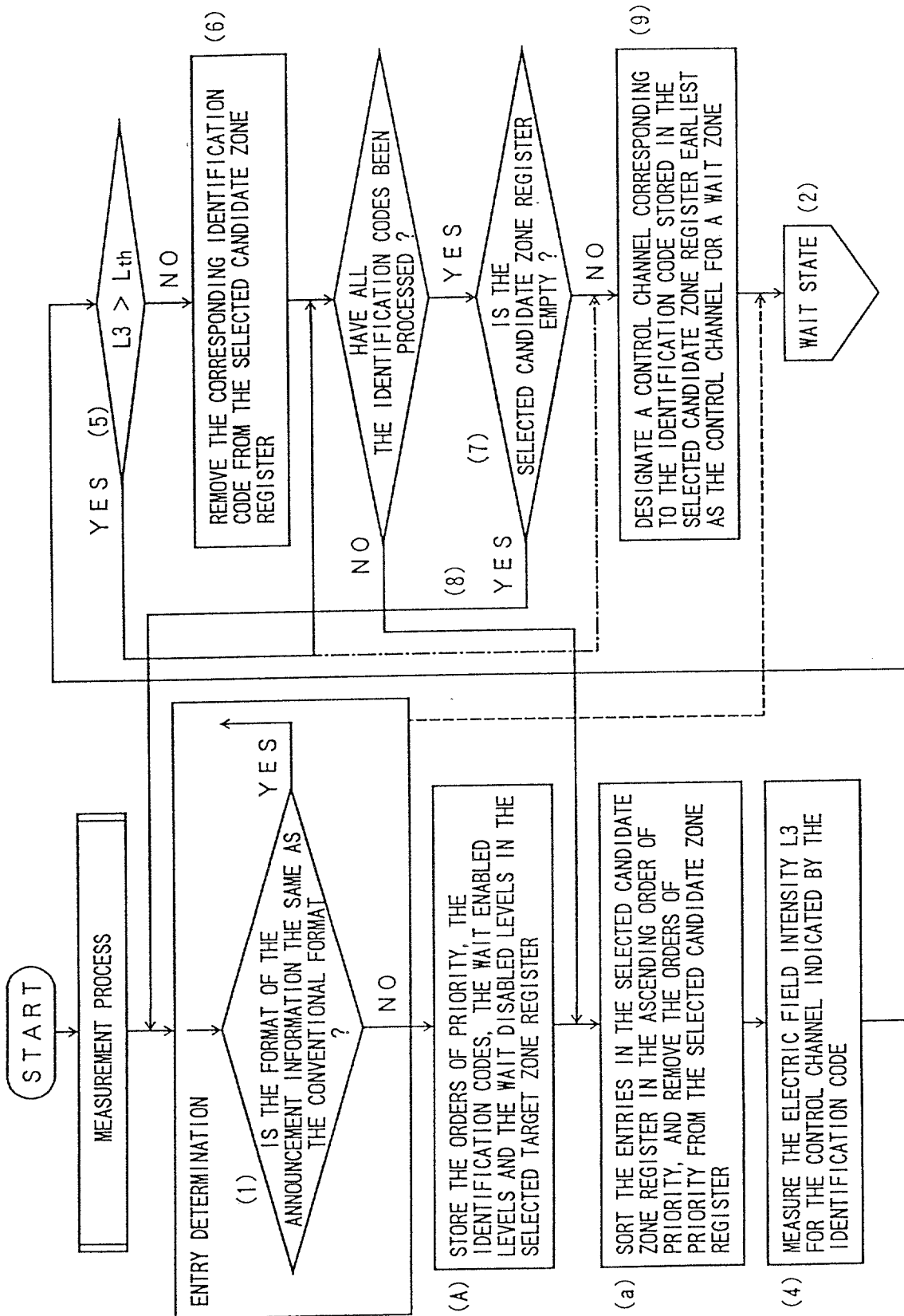


FIG. 15

FIG. 14

MESSAGE TYPE
⋮
MOBILE STATION TRANSMISSION POWER SPECIFICATION
ORDER OF PRIORITY P_1
CONTROL CHANNEL IDENTIFICATION CODE C_1
WAIT ENABLED LEVEL L_{th1}
WAIT DISABLED LEVEL ℓ_{th1}
⋮
ORDER OF PRIORITY P_4
CONTROL CHANNEL IDENTIFICATION INFORMATION C_4
WAIT ENABLED LEVEL L_{th4}
WAIT DISABLED LEVEL ℓ_{th4}
LOCATION REGISTERED AREA MULTIPLEX LEVEL
⋮

452300 59908380

FIG. 16

FIG. 15

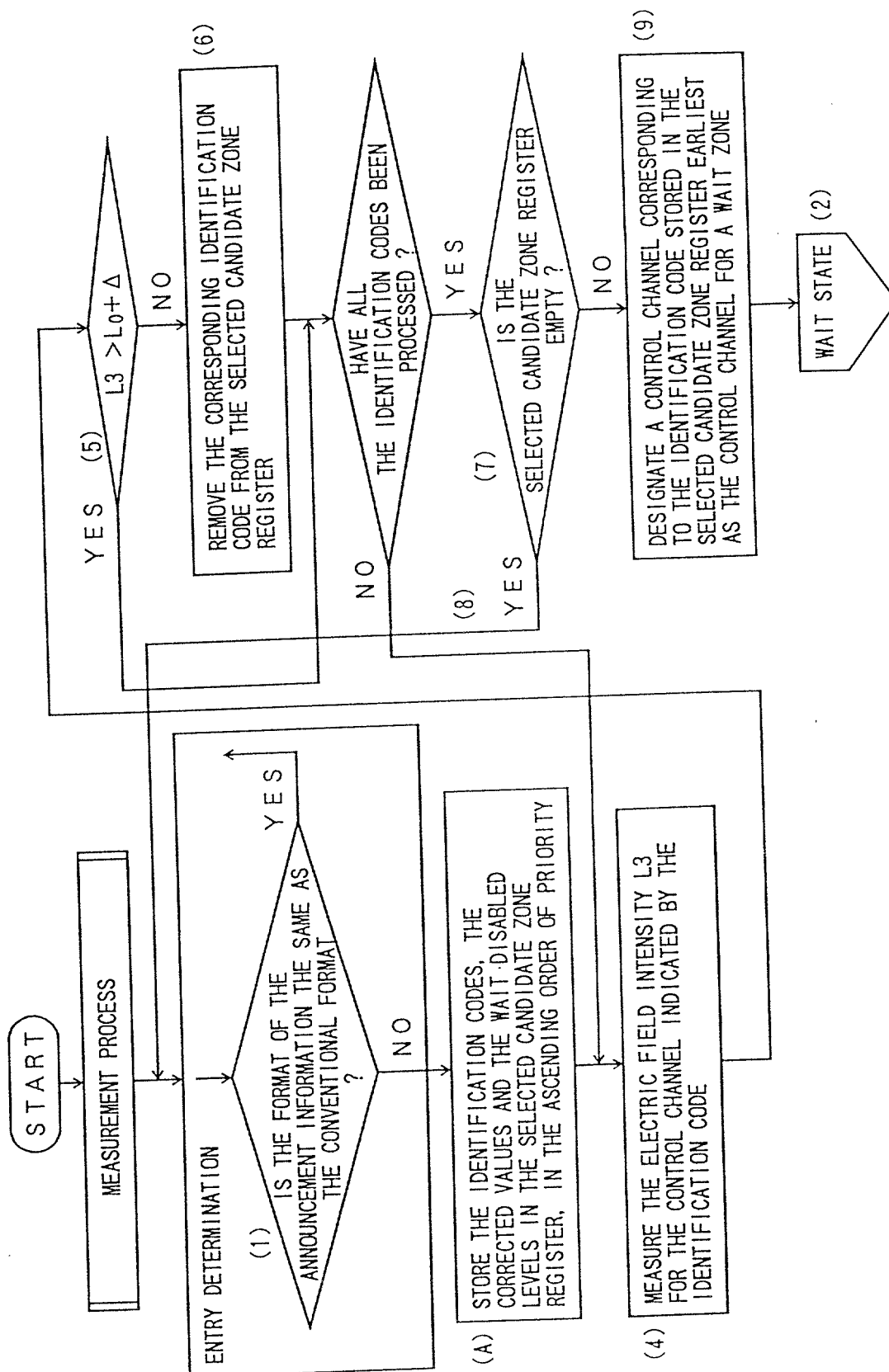


FIG. 17

~~FIG. 16~~

MESSAGE TYPE
⋮
MOBILE STATION TRANSMISSION POWER SPECIFICATION
ORDER OF PRIORITY P_1
CONTROL CHANNEL IDENTIFICATION INFORMATION C_1
CORRECTED VALUE Δ_1
WAIT DISABLED LEVEL ℓ_{th1}
⋮
ORDER OF PRIORITY P_4
CONTROL CHANNEL IDENTIFICATION INFORMATION C_4
CORRECTED VALUE Δ_4
WAIT DISABLED LEVEL ℓ_{th4}
LOCATION REGISTERED AREA MULTIPLEX LEVEL
⋮

08880664 03397

FIG. 18

FIG. 17

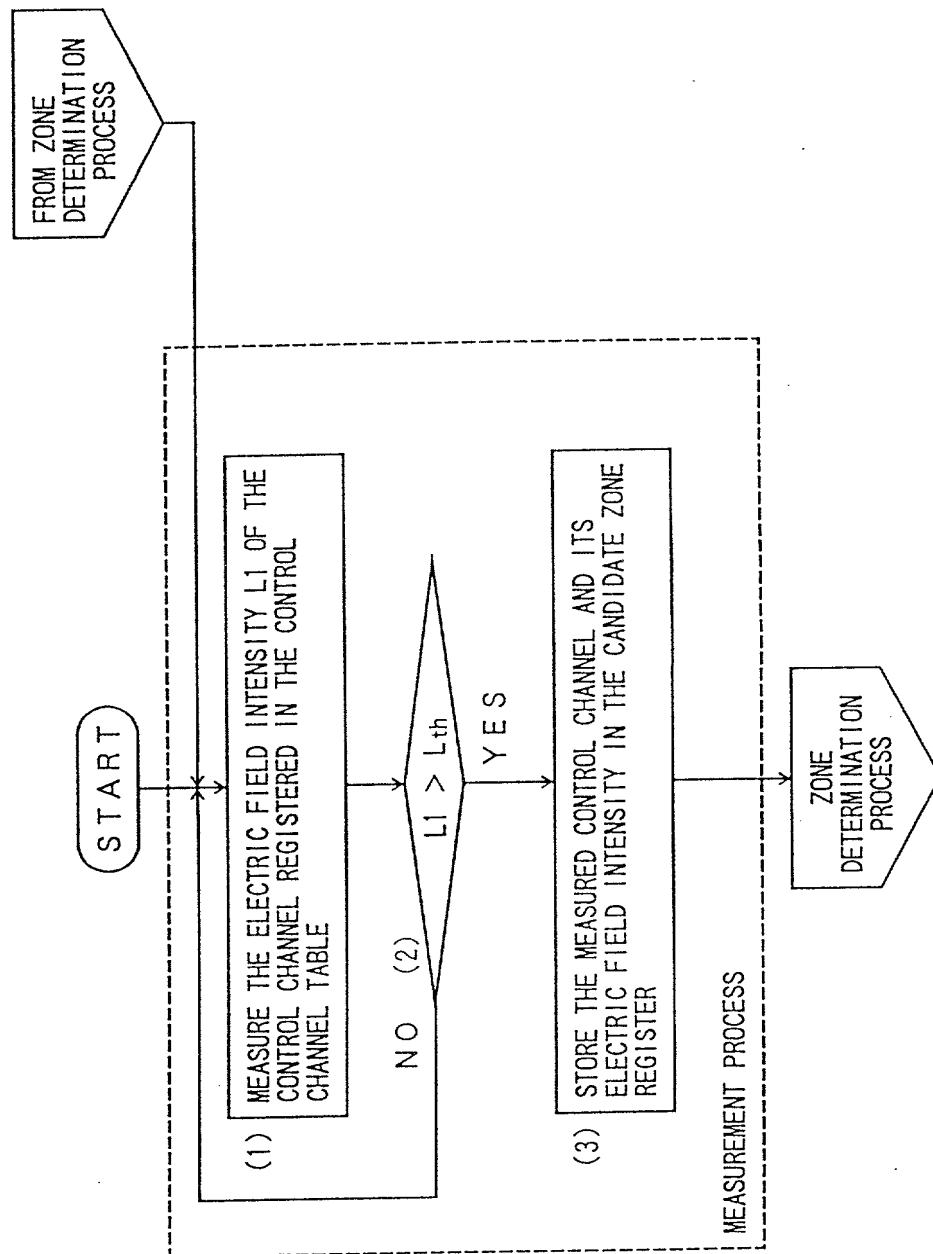
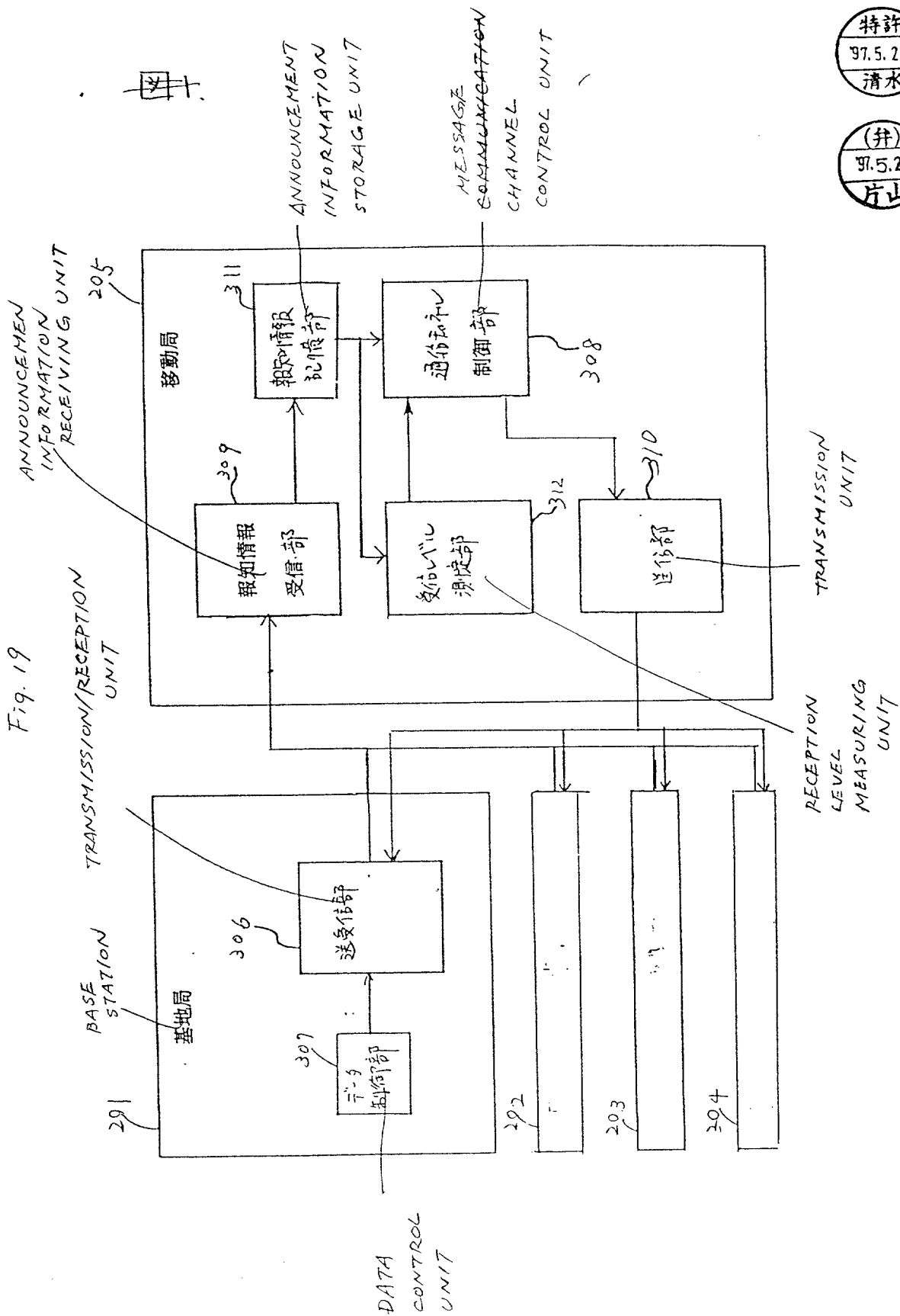


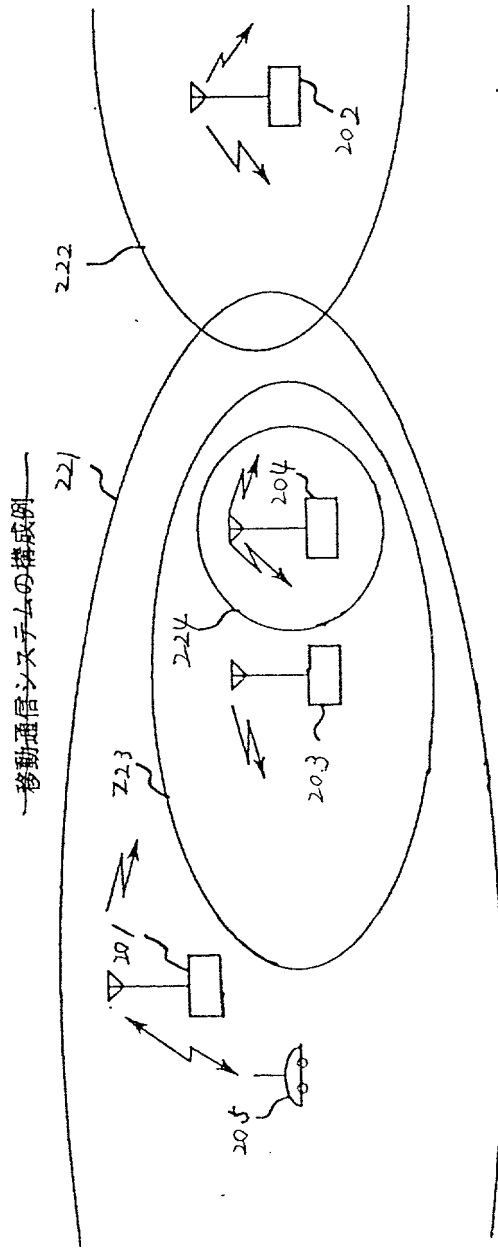
Fig. 19



特許
97.5.22
清水

(井)
97.5.21
片山

Fig. 20



2

Fig. 21A

Fig. 21A

DATA CONTROL UNIT

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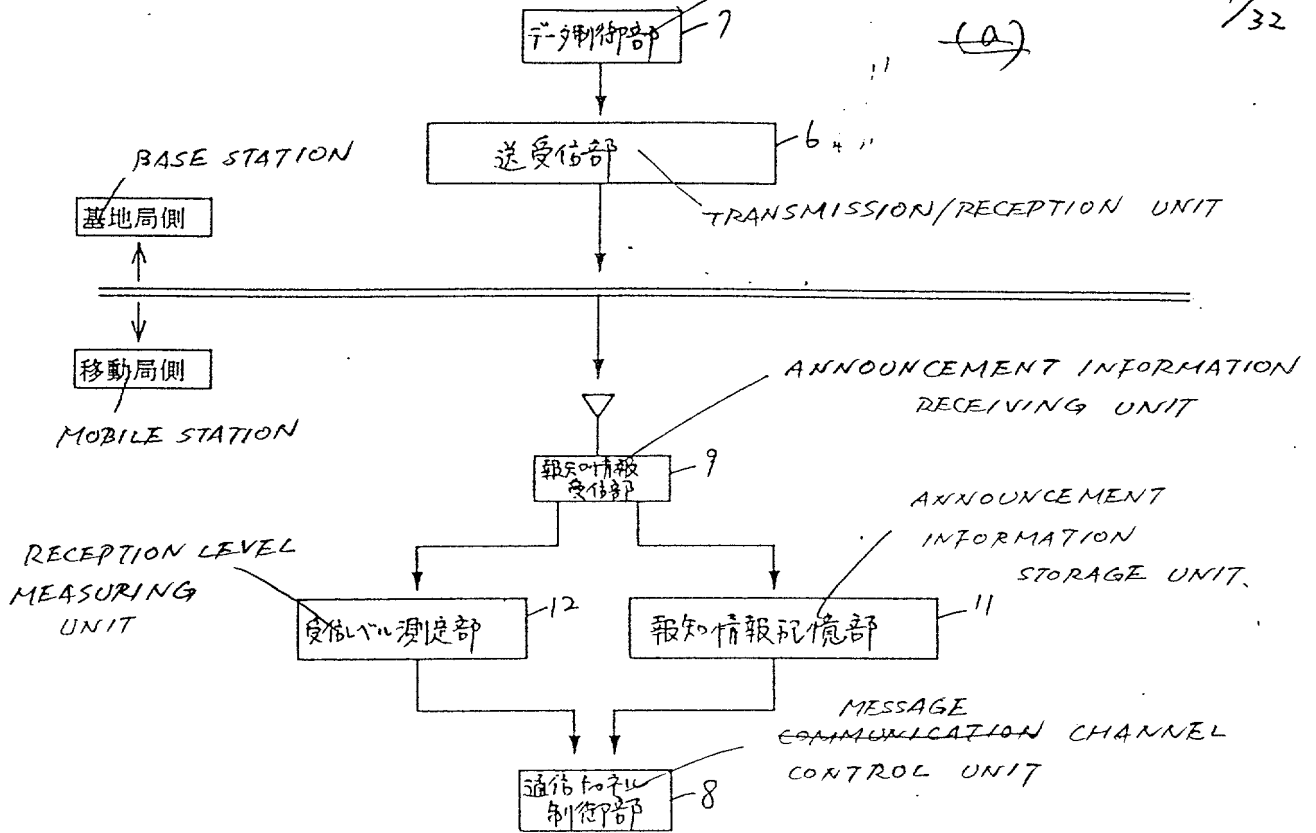


Fig. 21B

制御部は、発着呼時、先に基地局から受信した選択優先順位情報を基に、選択優先順位の高い順に該当基地局からの受信レベルを測定する。

移動局は発着呼の際に、選択優先順位基地局が高く、該当基地局からの受信レベルが、しきい値よりも高い基地局に対し、チャネル割り当て要求を送出する。

原理説明図

WHEN ORIGINATING A CALL OR RECEIVING A CALL, THE MOBILE STATION ISSUES A REQUEST FOR A MESSAGE COMMUNICATION CHANNEL TO THE HIGHEST-ORDER BASE STATION OF THOSE BASE STATIONS THAT PROVIDE A RECEPTION LEVEL HIGHER THAN A THRESHOLD LEVEL

MESSAGE
BEFORE ORIGINATING A CALL OR RECEIVING A CALL, THE COMMUNICATION CHANNEL CONTROL UNIT MEASURES THE LEVEL OF RECEPTION FROM THE BASE STATIONS IN THE DESCENDING ORDER OF PRIORITY, BASED ON THE ORDER OF PRIORITY RECEIVED FROM A BASE STATION

Fig 22

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報知情報の例

MESSAGE TYPE

NETWORK CODE

RESTRICTION INFORMATION

INFORMATION INDICATING THE ORDER OF PRIORITY

LOCATION CODE

MAXIMUM REPORTED NUMBER OF CHANNELS

PERCH CHANNEL CODE

ADDITIONAL INFORMATION ENTRY

LOCATION REGISTRATION TIMER

OPERATOR OPTION

CONTROL CHANNEL CONFIGURATION INFORMATION

MOBILE STATION TRANSMISSION POWER SPECIFICATION

FOR CONTROL CHANNEL

SOURCE STATION

WAIT ENABLED LEVEL

WAIT DISABLED LEVEL

LOCATION REGISTERED AREA MULTIPLE LEVEL

NUMBER OF PERCH CHANNELS TO BE SEARCHED FOR DETERMINATION OF A ZONE

INFORMATION ENTRY

DIRECTION

DOWNSTREAM

REMARKS

情報要素	方向	備考
メッセージ種別	下り	
網番号		
規制情報		
制御チャネル構造情報		
移動局送信電力指定		制御チャネル用
選択優先順位情報		自局用
待ち受け許可レベル		
待ち受け劣化レベル		
位置登録エリア多重数 (N)		1, 2, 4, 8 or 16
位置番号		第1番目 1st
§		§
位置番号		第n番目 nth
最大報告チャネル数		0 ~ M
在圏ゾーン/セクタ判定用 とまり木チャネル数 (M)		0 ~ 20
とまり木チャネル番号		第1番目 1st
§		§
とまり木チャネル番号		第M番目 Mth
位置登録タイマ		
拡張情報要素 (K)		0 ~ 127
(拡張情報要素)		オペレーション用

Fig 23

報知情報の例

MESSAGE CODE	情報要素	方向	備考
NETWORK CODE	メッセージ種別	下り	DOWNSTREAM
RESTRICTION INFORMATION	網番号		
	規制情報		
	制御チャネル構造情報		
	移動局送信電力指定		制御チャネル用
	待ち受け許可レベル		WAIT ENABLED LEVEL
	待ち受け劣化レベル		WAIT DISABLED LEVEL
MAXIMUM REPORTED NUMBER OF CHANNELS	位置登録エリア多重数 (N)		1, 2, 4, 8 or 16
	位置番号		第1番目 1st
	CODE		
	位置番号		第n番目 nth
	最大報告チャネル数		0 ~ M
PERCH CHANNEL CODE	在圏ゾーン/セクタ判定用		0 ~ 20
	とまり木チャネル数 (M)		1st
	とまり木チャネル番号		第1番目 (選択優先順位順に送出)
	CODE		
	とまり木チャネル番号		第M番目 Mth
	位置登録タイマ		
	拡張情報要素 (K)		0 ~ 127
	(拡張情報要素)	↓	オペレーション用

CONTROL CHANNEL CONFIGURATION INFORMATION

MOBILE STATION TRANSMISSION POWER SPECIFICATION FOR CONTROL CHANNEL

LOCATION REGISTERED AREA MULTIPLEX LEVEL

NUMBER OF PERCH CHANNELS TO BE SEARCHED FOR DETERMINATION OF A ZONE

(TRANSMITTED IN THE DESCENDING ORDER OF PRIORITY)

OPERATOR OPTION

ADDITIONAL INFORMATION ENTRY

LOCATION REGISTRATION TIMER

Fig. 24

MESSAGE TYPE	情報要素	方向	備考
メッセージ種別	メッセン	下り	
ネットワークコード	網番号		CONTROL CHANNEL CONFIGURATION INFORMATION
RESTRICTION INFORMATION	規制情報		MOBILE STATION TRANSMISSION POWER SPECIFICATION
	制御チャネル構造情報		FOR CONTROL CHANNEL
	移動局送信電力指定		制御チャネル用
	待ち受け許可レベル		WAIT ENABLED LEVEL
	待ち受け劣化レベル		WAIT DISABLED LEVEL
	位置登録エリア多重数 (N)		1, 2, 4, 8 or 16
MAXIMUM REPORTED NUMBER OF CHANNELS	位置番号	LOCATION CODE	第1番目 ①
	位置番号		第N番目 ②
	最大報告チャネル数		0 ~ M
PERCH CHANNEL CODE	在圏ゾーン/セクタ判定用とまり木チャネル数 (M)		0 ~ 20
	とまり木チャネル番号		第1番目 1st
	選択優先順位情報		(第1番目とまり木チャネルの優先順位情報)
	とまり木チャネル番号		第M番目 Mth
	選択優先順位情報		(第M番目とまり木チャネルの優先順位情報)
	位置登録タイマ		
	拡張情報要素 (K)		0 ~ 127
	(拡張情報要素)		オペレーション用

報知情報の例

INFORMATION ENTRY

DIRECTION DOWNSTREAM

REMARKS

情報要素

方 向

備 考

メッセン

網番号

規制情報

制御チャネル構造情報

移動局送信電力指定

待ち受け許可レベル

待ち受け劣化レベル

位置登録エリア多重数 (N)

位置番号

LOCATION CODE

位置番号

最大報告チャネル数

在圏ゾーン/セクタ判定用とまり木チャネル数 (M)

とまり木チャネル番号

選択優先順位情報

とまり木チャネル番号

選択優先順位情報

位置登録タイマ

拡張情報要素 (K)

(拡張情報要素)

CONTROL CHANNEL CONFIGURATION INFORMATION

MOBILE STATION TRANSMISSION POWER SPECIFICATION

FOR CONTROL CHANNEL

制御チャネル用

WAIT ENABLED LEVEL

WAIT DISABLED LEVEL

1, 2, 4, 8 or 16

第1番目 ①

第N番目 ②

0 ~ M

0 ~ 20

第1番目 1st

(第1番目とまり木チャネルの優先順位情報)

第M番目 Mth

(第M番目とまり木チャネルの優先順位情報)

LOCATION REGISTERED AREA MULTIPLEX LEVEL

NUMBER OF PERCH CHANNELS TO BE SEARCHED FOR DETERMINATION OF A ZONE

INFORMATION INDICATING THE ORDER OF PRIORITY OF THE 1st PERCH CHANNEL

INFORMATION INDICATING THE ORDER OF PRIORITY OF THE Mth PERCH CHANNEL

ADDITIONAL INFORMATION ENTRY

OPERATOR OPTION

INFORMATION INDICATING THE ORDER OF PRIORITY

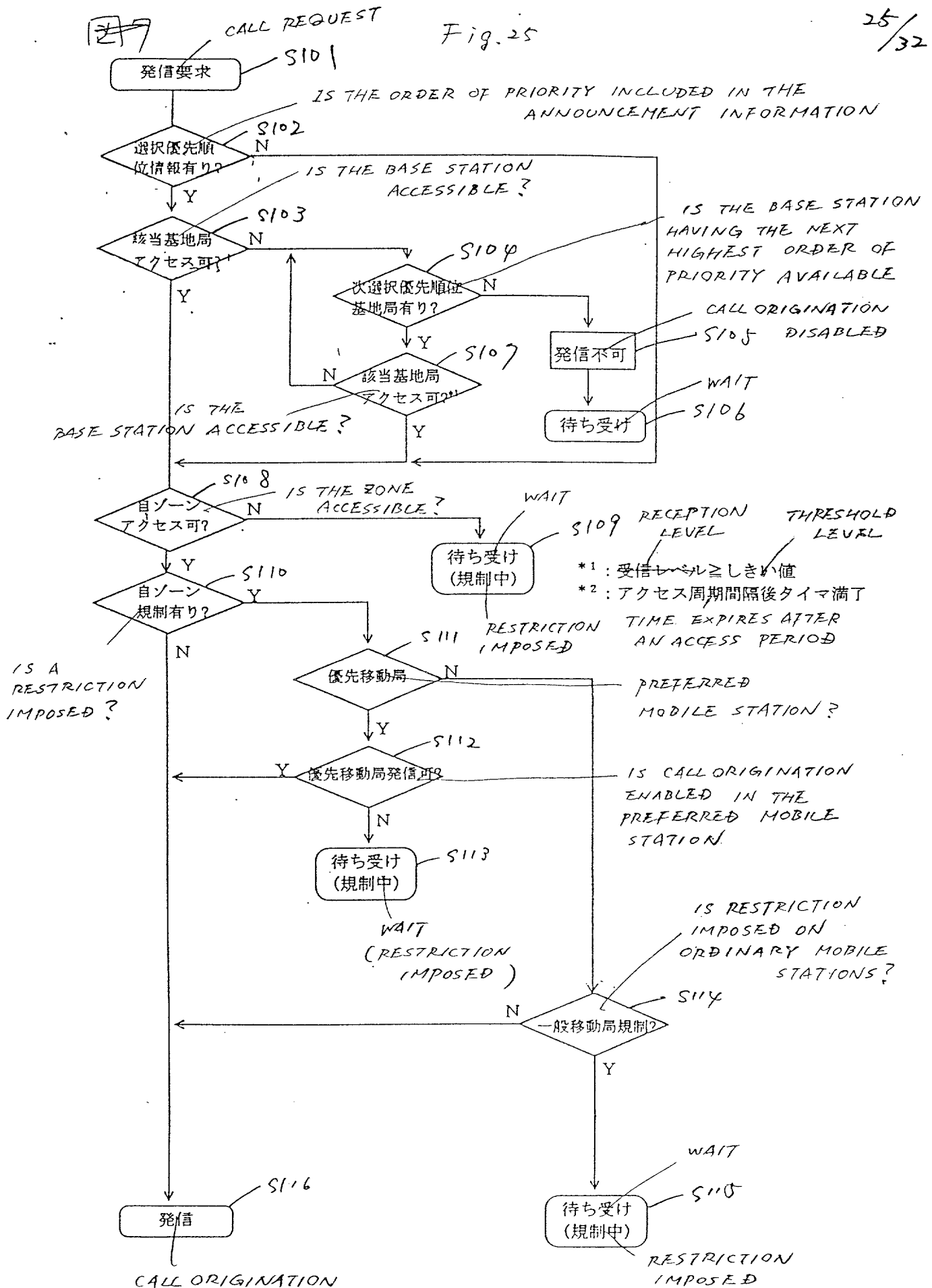
LOCATION REGISTRATION TIMER

25/32

CALL REQUEST

Fig. 25

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発信時の動作フロー

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BASE STATION 202

BASE STATION 204

BASE STATION 201

BASE STATION 203

MS MOBILE STATION 205

MEASURE THE RECEPTION LEVEL

受信レベル測定 (X1)
" (X2)
受信レベル測定 (X3)
" (X4)

受信レベル: X2 < X4 < X3 < X1
RECEPTION LEVEL

移動局判断

選択優先順位として
基地局4 > 基地局3 > 基地局1 > 基地局2
という条件とする

周辺とまり木チャネル測定
1 ~ n

発信要求

CALL REQUEST

*1 — : 周波数切替

FREQUENCY SWITCHING

報知情報

DETERMINATION ANNOUNCEMENT
IN THE MOBILE STATION
INFORMATION
MEASURE THE RECEPTION
LEVEL OF THE PERCH
CHANNELS

ANNOUNCEMENT
INFORMATION

報知情報

REQUEST A MESSAGE
COMMUNICATION CHANNEL

通信チャネル要求

SPECIFY A MESSAGE
COMMUNICATION
CHANNEL

通信チャネル指定

SPEECH

TCH (音声)

発信時の動作シーケンス

THE ORDER OF PRIORITY :

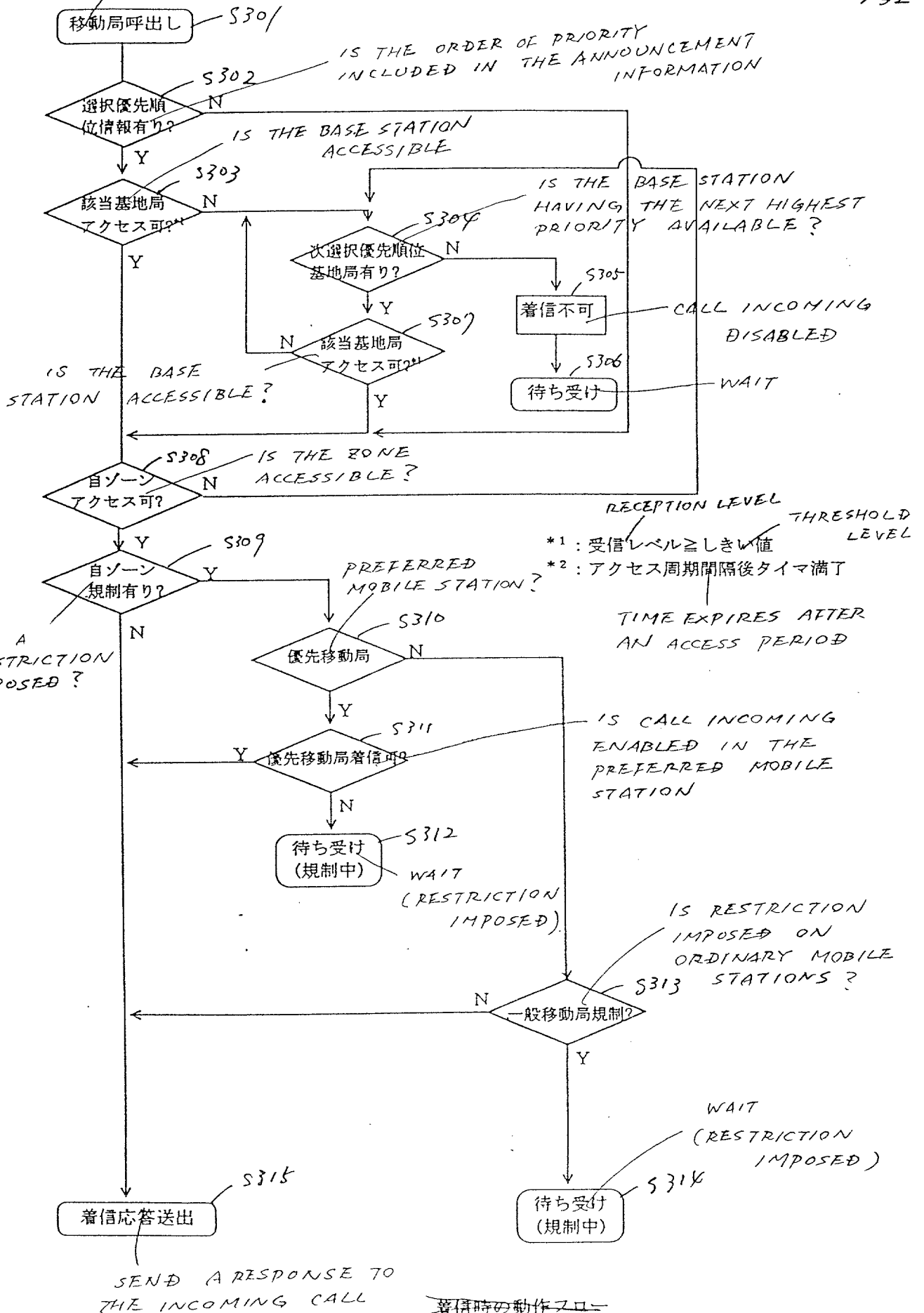
BASE STATION 204 > BASE STATION 203 > BASE STATION 201 > BASE STATION 202

IS ASSUMED

MOBILE STATION IS CALLED

Fig. 27

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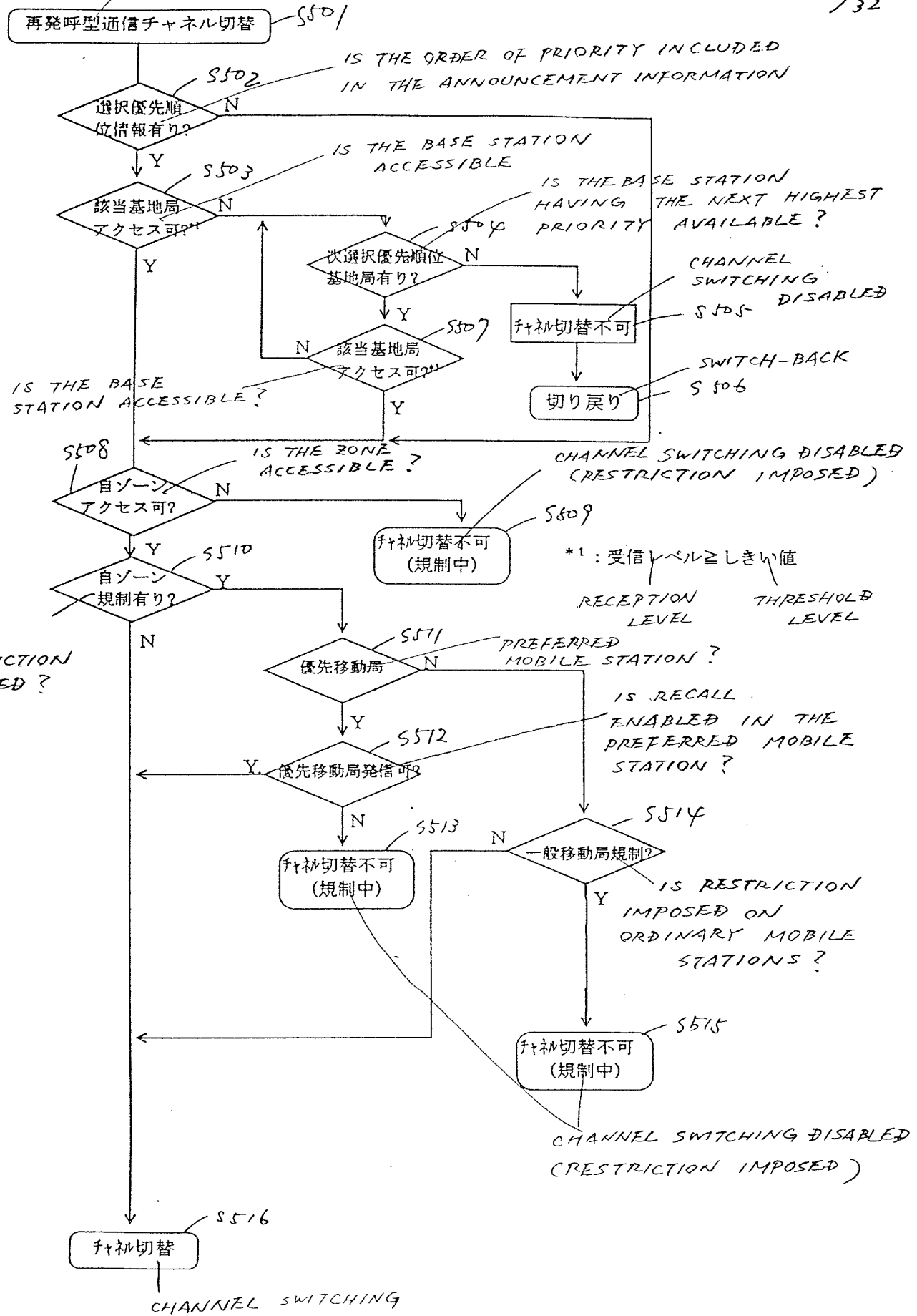
9/

34/71

RECALL COMMUNICATION CHANNEL SWITCHING

29/32

Fig. 29



11/

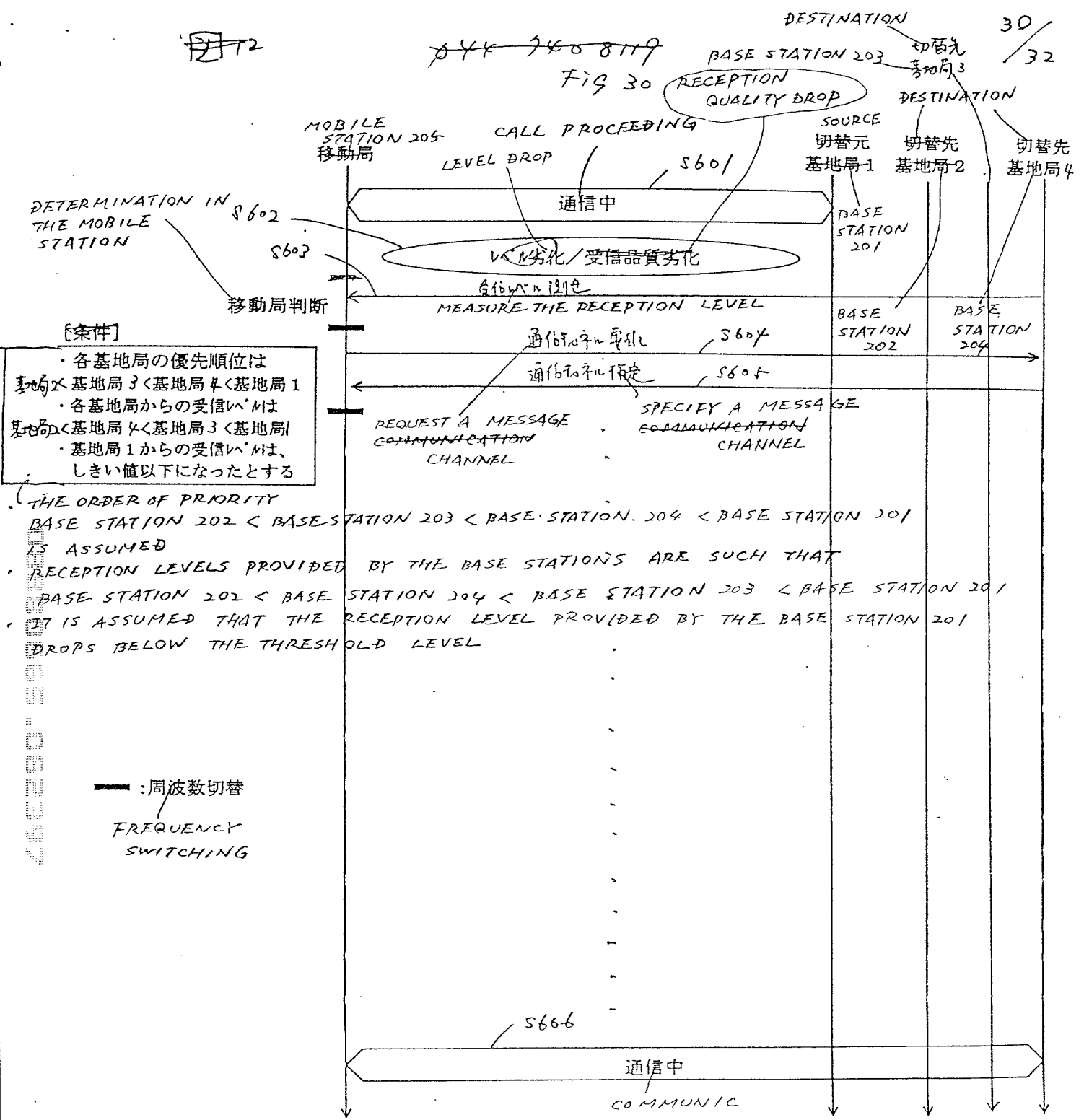
12

044 740 8119

DESTINATION

30 / 32

Fig 30



再発呼型チャネル切替制御シーケンス図

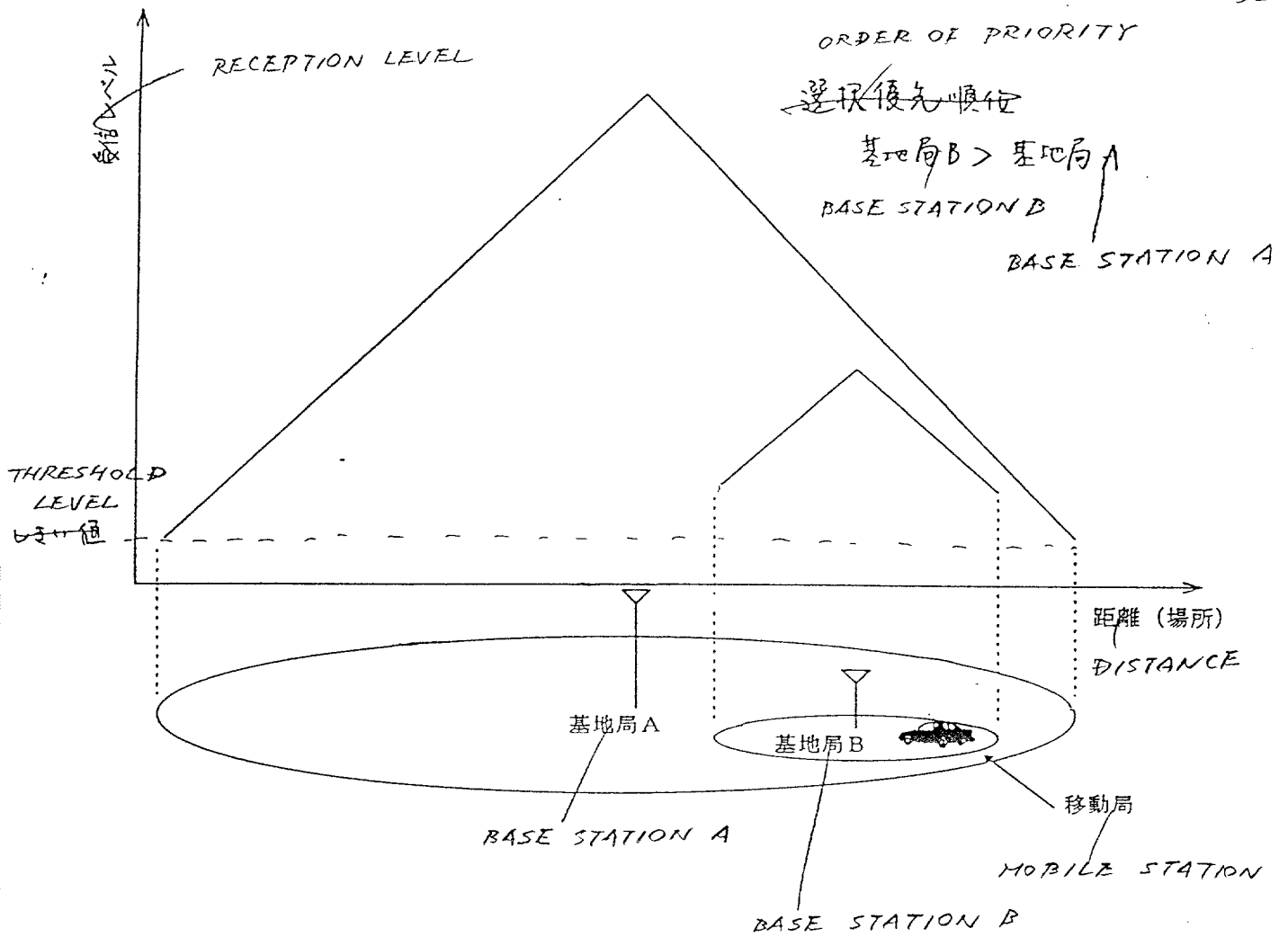


Fig. 32

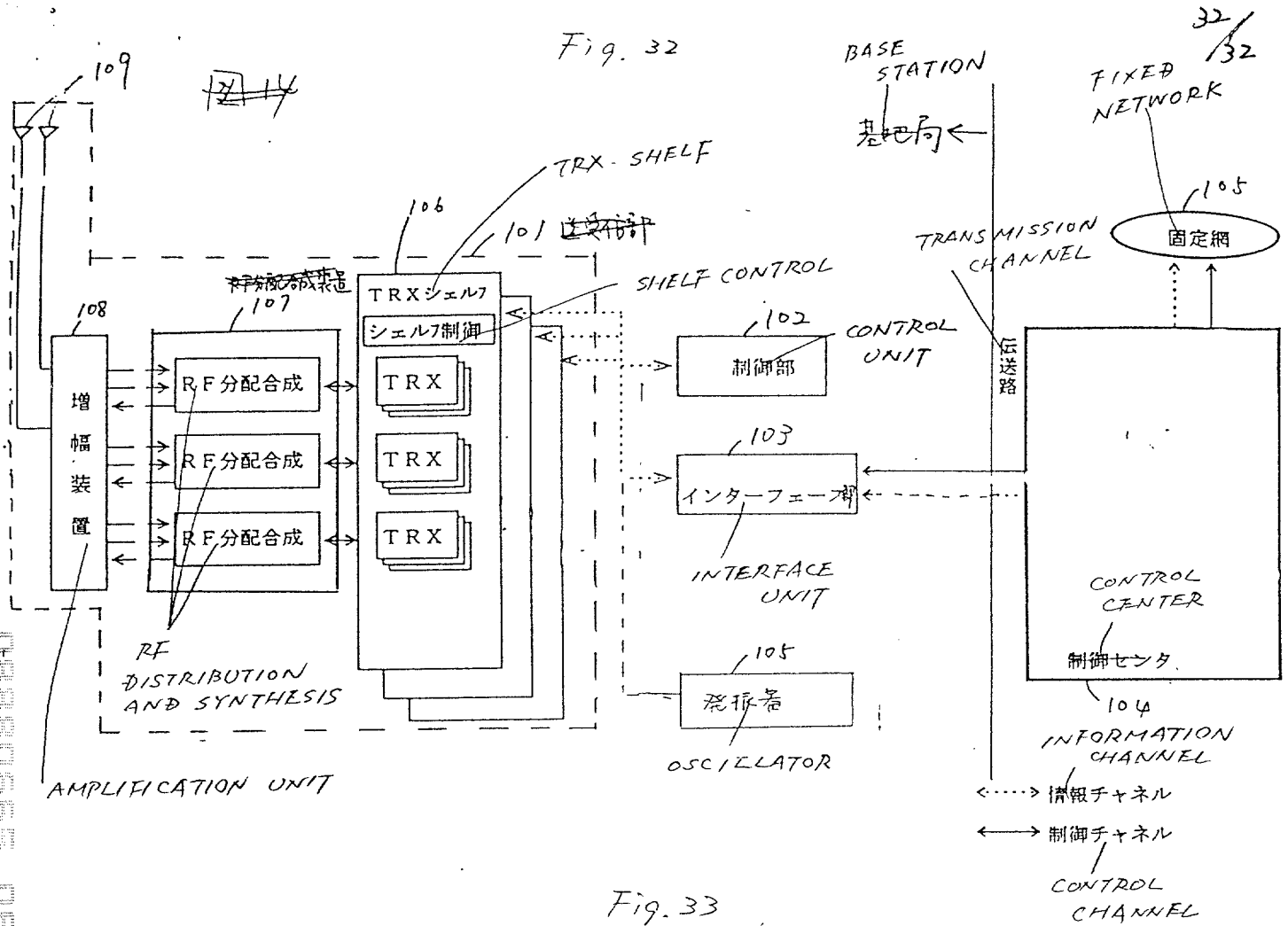
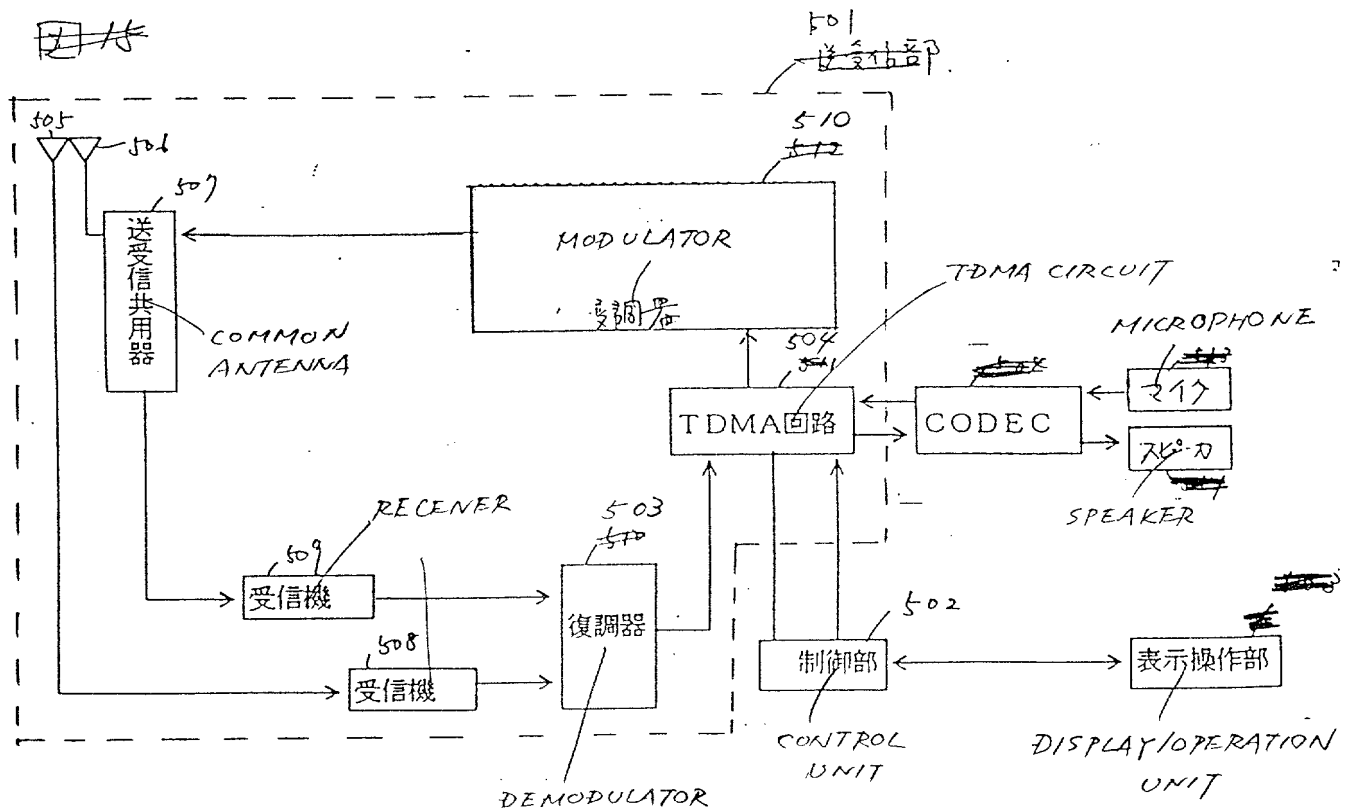


Fig. 33



DECLARATION FOR PATENT APPLICATION Docket No. FUJI 14.341

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled MOBILE COMMUNICATION SYSTEM ENABLING EFFICIENT USE OF SMALL-ZONE BASE STATIONS

the specification of which

(check one) ☒ is attached hereto.

☐ was filed on _____ as

Application Serial No. _____

and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s) (Patent)			Priority Claimed	
<u>NO. 8-163330</u>	<u>Japan</u>	<u>24 / June / 1996</u>	<input checked="" type="radio"/> Yes	<input type="radio"/> No
(Number)	(Country)	(Day/Month/Year Filed)		
<u>No. 9-155286</u>	<u>Japan</u>	<u>12 / June / 1997</u>	<input checked="" type="radio"/> Yes	<input type="radio"/> No
(Number)	(Country)	(Day/Month/Year Filed)		
_____	_____	_____	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)		

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

_____	_____	_____
(Application Serial No.)	(Filing Date)	(Status - patented, pending, abandoned)
_____	_____	_____
(Application Serial No.)	(Filing Date)	(Status - patented, pending, abandoned)

I hereby appoint as my attorney and agent Aaron B. Karas, Reg. No. 18,923, Samson Helfgott, Reg. No. 23,072 and Emma Shleifer, Reg. No. 29,734 to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Address all correspondence to: **HELFGOTT & KARAS P.C.**
60th Floor
Empire State Building
New York, New York 10118-0110
Telephone No. (212) 643-5000

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor Hajime Hasegawa
Inventor's signature Hajime Hasegawa Date June 18, 1997
Residence Kawasaki-shi, Kanagawa, Japan Citizenship Japan
Post Office Address c/o FUJITSU LIMITED, 1-1, Kamikodanaka 4-chome, Nakahara-ku,
Kawasaki-shi, Kanagawa, 211 Japan

Full name of second joint inventor, if any _____
Second Inventor's signature _____ Date _____
Residence _____ Citizenship _____
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